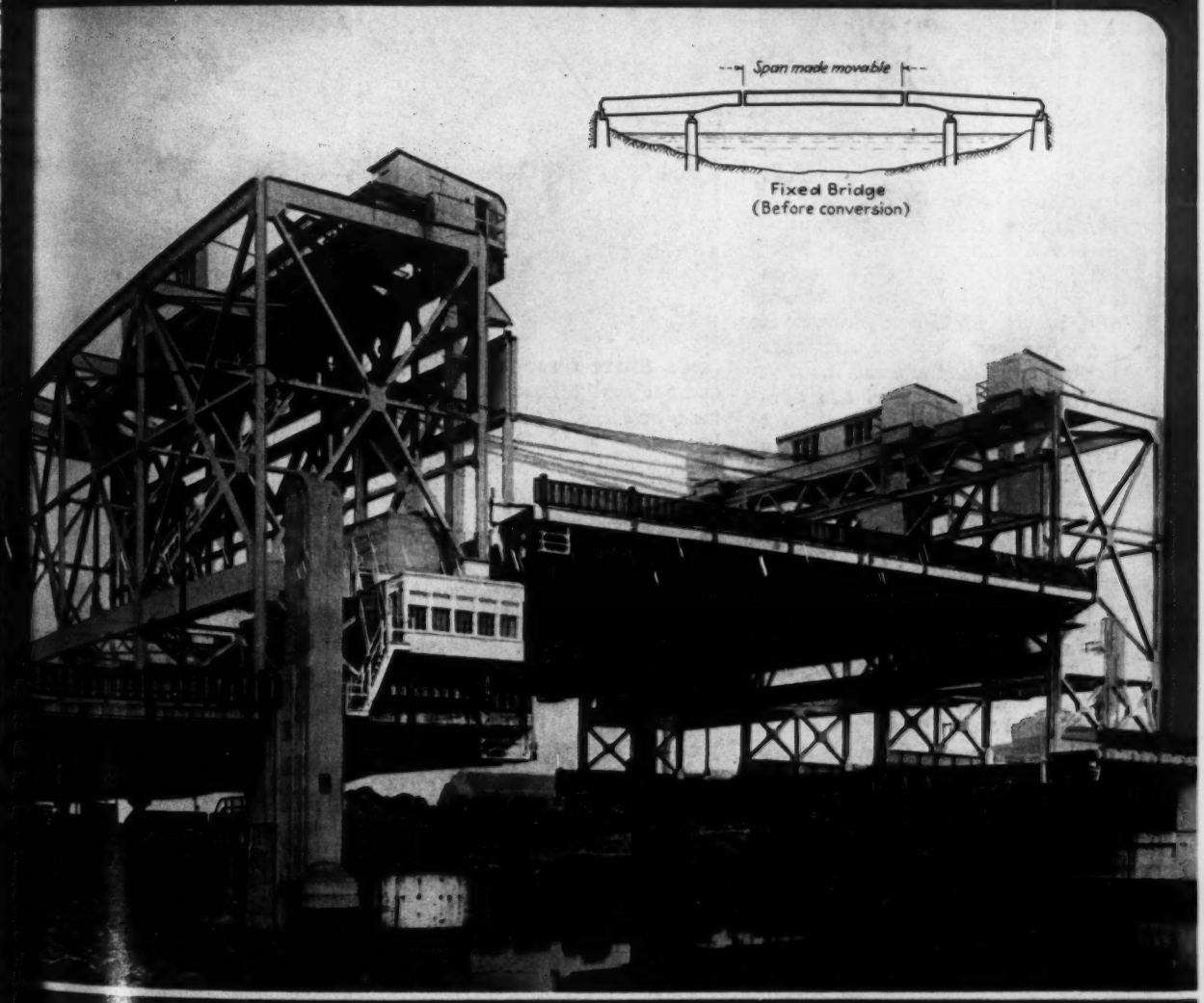
ENGINEERING NEWS-RECORD

MARCH 23, 1944

Conversion of this fan-tail fixed bridge at Chicago into a 88-ft. vertical lift span makes possible the navigation of war craft on the Great Lakes-to-Gulf waterway



RAPID CONCRETE PROPORTIONING

BYERS WROUGHT IRON BLAST PLATES

keep this bridge from wearing out . . .

FROM BELOW

When this bridge at Cincinnati was designed by Chesapeake and Ohio Railroad engineers, they added an *extra* member that will mean a lot of extra life . . . wrought iron blast plates. Everyone who has seen what locomotive blast gases can do to unprotected bridge structures will recognize the soundness of *transferring* this punishing wear to plates qualified to stand it.

When the conditions are considered, it is no wonder that blast gases are so destructive. They are expelled at high velocity, carrying cinders and other entrained materials. Any flaky, loosely held protective film is "sand-blasted" off, leaving the underlying metal exposed, and highly vulnerable to corrosive attack. The gases themselves contain carbon and sulfur compounds that unite with moisture to form corrosive acids, which are condensed on the cooler metal surfaces . . . to repeat the destructive cycle.

No ordinary material could stand this punishment . . . but wrought iron is no ordinary material. The tiny fibers of glass-like silica slag that are threaded through the matrix of high-purity iron help to anchor the protective film, and make it relatively much more adherent, and much more resistive to the "sand-blasting" action. Then these fibers serve as baffles, to combat and diffuse corrosive attack, and inhibit pitting and penetration.

Important though these features are, they are not wrought iron's only advantages in blast plate service. The material is relatively light in weight, easy to fabricate, easy to weld, and is not adversely affected by the extreme temperature ranges that are encountered.

The engineering departments of a number of the country's leading railroads, and the highway departments in more than half the states, regularly use this proven method of reducing the maintenance expense of overpass structures.

A few of the many installatio of Byers Wrought Iron Blast Pla are illustrated and described in technical bulletin, "Wrought I in Bridge Construction." Detail drawings, prepared through friendly cooperation of the vario railroads involved, show the me ods of attaching the plates. We w be very glad to send you a comp mentary copy, and are sure y will find it interesting and help

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CONSTRUCTION TRENDS

Notes on significant movements in the construction industry

Progress in Postwar Sanitary Construction

WATERWORKS AND SEWERAGE projects *proposed* for postwar construction during 1943 total $625,553,000—$237,354,000 for waterworks, and $388,199,000 for sewerage. These *proposed* sanitary projects account for 12.2 percent of the $5,101,087,000 total of *proposed* construction, with waterworks responsible for 4.6 percent and sewerage for 7.6 percent.

Of the *proposed* waterworks volume, $58,874,000, or 25 percent had *plans underway or completed* at the end of the year. These projects in the *planning stage* amount to 3.6 percent of the $1,647,960,000 for all types of postwar construction in the *planning stage*.

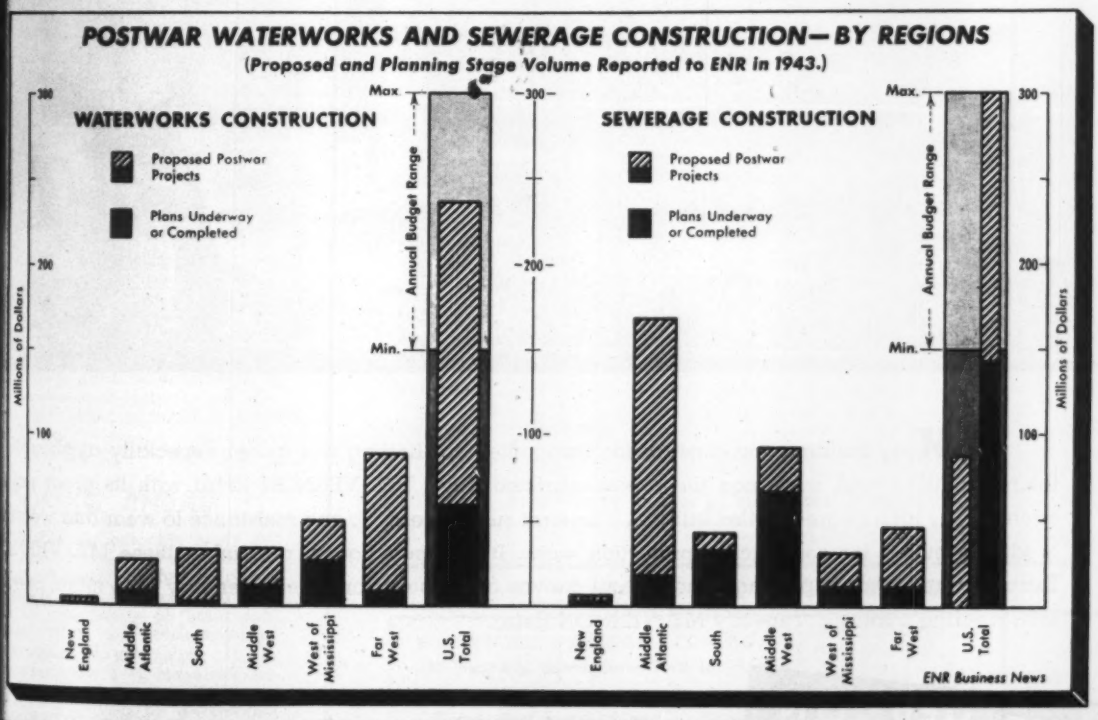
A comparison of the *proposed* waterworks volume with *ENR* annual budget estimates for postwar waterworks construction reveals that *proposed* volume exceeds the minimum annual budget, $200,000,000, by 18½ percent, but is 21 percent below the maximum, $300,000,000. *Planning stage* volume is 71 percent below the minimum budget, and 80 percent under the maximum.

Sewerage projects with *plans underway or completed* total $144,021,000 and make up 37 percent of the *proposed* sewerage volume. These projects in the *planning stage* are 8.7 percent of the total reported in U.S.

Proposed sewerage volume tops the minimum annual budget of $200,000,000 by 94 percent and exceeds the maximum, $300,000,000, by 29 percent. Projects in the *planning stage* are already within 28 percent of the minimum year's budget and within 52 percent of the maximum budget. Sewerage planning has made more progress than any other class of work except bridges.

With a *proposed* waterworks total of $88,895,000, the Far West tops all other sections, but less than 10 percent of these projects are in the *planning stage*. West of Mississippi has $27,119,000, or 54 percent, with *plans underway or completed*.

Middle Atlantic with $168,856,000 in *proposed* sewerage projects leads the nation, but has only 11 percent in the *planning stage*. Middle West heads planners with $67,159,000, or 72 percent in this stage.



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. . . Time is on the Side of Quality

Many building and construction companies are finding this axiom especially applicable to their tarpaulins and coverings these war-restricted days. MT. VERNON Extra with its great tensile strength . . . high degree of flexibility . . . uniform ruggedness . . . and resistance to wear and weather, is ideally suited for construction-protection work. It will pay you to remember these MT. VERNON Extra features when replacing your present canvas as construction gets under way once more. Specify long-wearing quality . . . specify MT. VERNON Extra.

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JOHN ABBINK, *Publisher*

WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Manager*

...l. 132 MARCH 23, 1944 No. 12

...OMING NEXT

Highway departments throughout ...e country are faced with an ever ...creasing amount of pavement de...rioration as a result of excessive ...ads of wartime transportation. This ...ndition, plus a shortage of man...wer and vital equipment, has ...reated a most critical maintenance ...blem. For two years Illinois has ...en pioneering in the field of high...y maintenance by contract. What ...s been learned by this expe...ence is worth the attention of all ...ighway engineers. The Illinois ...rogram will be outlined in the ...pril 6 issue.

• Much has been written, pro and ...n, with respect to the many pro...ects this country has undertaken ...n Latin America as part of our ...od neighbor policy. One of the ...ost important of these—for Latin ...mericans, and eventually for our...lves—is our program for the ad...ancement of health and sanitation. ...he engineering aspects of the pro...ram, with special relation to water ...upply and sewerage problems, will ...e discussed in a comprehensive re...ort to be published in the April 6 ...sue.

• The rust inhibitive qualities of ...ed lead as a protective coat for ...tructural steel has long been recog...ized. However, the type of pig...ent and vehicles that should be ...combined to accomplish best re...ults under varying conditions of ...exposure is still little understood. A ...well-known paint authority will dis...cuss this subject in detail in *ENR* ...for April 6.

LOOKING AHEAD

• Graphic methods offer many ad...vantages in the field of structural ...design. Not only do they provide a ...means of problem solving but they ...aid in visualization of basic con...cepts, and in the development of ...new analytical procedures. D. B. ...Steinman, New York consulting en...gineer, will discuss the application ...of graphic methods for determining ...fixed end moments, and in general ...for solving continuous beams, in an ...early issue. This article will be fol...lowed by another in which Mr. Stein...man will present a new method for ...determining moments in continuous ...beams and framed bents—the meth...od of "linked rigidities."

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CONCRETE HIGHWAY NEWS

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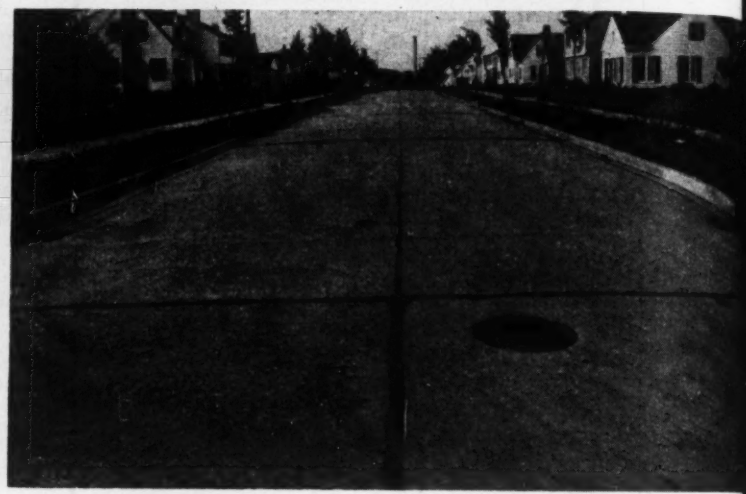
MILWAUKEE SOLVES SCALING OF CITY PAVEMENTS

Atlas Duraplastic* air-entraining portland cement makes pavements resistant to de-icing salts and weather



North 45th Street, Milwaukee, after four winters of salt de-icing treatment. The left lane, made with normal portland cement, shows severe scaling. The right lane, made with Atlas Duraplastic air-entraining portland cement, is practically free from scaling. Both lanes were placed at the same time and subjected to identical service and treatment.

MILWAUKEE, Minneapolis, and other cities and states have found, through construction of their own test installations, that concrete pavements made with Atlas Duraplastic cement resist scaling due to salts used for ice removal as well as the effects of freezing and thawing weather.

Atlas Duraplastic is the result of six years' research and test on air-entraining portland cement by Universal Atlas. It is a true portland cement in which a small amount of air-entraining material, precisely determined for proper performance, is interground during manufacture.

Duraplastic (1) complies with current Federal and ASTM specifications; (2) renders concrete pavements highly resistant to scaling due to the action of salts used for ice removal; (3) protects concrete against the effects of freezing and thawing weather; (4) minimizes segregation and bleeding—concrete is more uniform throughout and more durable; (5) permits earlier finishing; (6) requires no additional material at the mixer; (7) called *Duraplastic* because it makes concrete more *durable* and more *plastic*.

For reports on city and state test highways and on the original research, write to our Technical Service Bureau.

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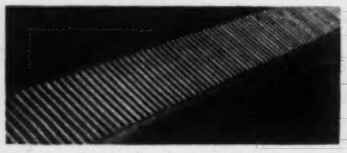
WHITE CONCRETE REFLECTING CURB MAKES DRIVING SAFER

Combines principles of light-reflection with reflective value of Atlas White cement



The scored faces of this curb (pictured above) and the fact that it is made with Atlas White cement are the reasons for its effectiveness.

As shown by the diagram below, these white faces reflect the headlights' beams *back to the driver's eyes*. This makes the curb highly visible. The light is not wasted as is the case with a smooth curb. And while rain makes a smooth curb practically invisible, it turns these reflective faces into even better "mirrors." This is why a White Concrete Reflecting Curb acts as a "White Guide to Safety"—night or day, rain or shine.

For greater safety on highways ask for a copy of the book, "A White Guide to Safety." Write to our Atlas White Bureau for full information on White Concrete Reflecting Curb.

A smooth curb (above) wastes light . . . reflects it up and away from the driver. A White Concrete Reflecting Curb (below) conserves light . . . reflects it back to the driver. A smooth curb is barely visible at night; a White Reflecting Curb stands out—bright and clear.

ENR-DC-2

UNIVERSAL ATLAS CEMENTS

UNIVERSAL PORTLAND • ATLAS PORTLAND • ATLAS WHITE • ATLAS DURAPLASTIC • ATLAS HIGH-EARLY

The Week In Engineering and Construction

GINEERING NEWS-RECORD • MARCH 23, 1944 • VOLUME 132 • NUMBER 12

A.R.E.A. centers attention on labor and materials

American Railway Engineering Association considers ways for keeping up supply of labor and materials for maintenance of track and structures

arting from its traditional prac- f devoting nearly all of its an- meeting to consideration of com- reports, the American Railway eering Association gave over a derable part of this year's meet- o the two major questions that conditions have raised for its ers: how to meet the shortage or and scarcity of materials. The g was held in Chicago, March , and was the first meeting that ssociation has had in two years, year's meeting having been can- due to the critical transporta- situation.

r conditions made it impractical he National Railway Appliance iation to hold the railway equip- show that was a feature of the E.A. meetings in prewar years. The A.A. did, however, participate by g the A.R.E.A. members as its s at the annual dinner Wednes- evening.

Special demands met

R. Clarke, president of the E.A., in opening the meeting, out- the manner in which activities of ssociation have been adjusted to new conditions brought about by ar. Because the association's nor- methods of functioning were to be too slow for answering t questions put up to it, the tors found it necessary to set up an gency arrangement for getting action on matters referred to for action by the War Produc- Board or the Office of Defense portation. Many A.R.E.A. specifi- ns were thus adjusted to meet ages of critical materials and were made mandatory by the .

mmittee assignments now are con- ted largely on questions raised by war conditions, action on routine matters being postponed in many instances. Research, especially that having a direct bearing on meeting war needs, is being continued actively under the sponsorship of the Association of American Railroads, of which the A.R.E.A. is the engineering division. The A.A.R. apropriation for continuation of this research in 1944 is $109,000, the largest yet made for that purpose. Research this year will be centered on rail manufacturing studies, made in cooperation with the steel companies—which research has resulted in a remarkable reduction in rail failures—on rail joints, on impact and on the relation of track stresses to the counterbalancing of locomotives.

W. S. Lacher, secretary, reported a slight gain in membership and a most unusual demand for the association's publication.

New president, A.R.E.A.

Frank R. Layng is a native of Salem, Ohio, and a graduate of the University of Pittsburgh. He began railway service in 1897 as a rodman on the Pennsylvania but three years later shifted to the Bessemer and Lake Erie where he has served progressively as draftsman, assistant engineer, engineer of bridges and buildings, engineer of tracks, assistant chief engineer and chief engineer. He has been a member of the American Railway Engineering Association since 1909.

Labor shortages

Discussion of problems raised by the shortage of labor was opened by E. T. Howson, western editor of *Railway Age* and chairman of the subcommittee in charge of the association's labor studies.

This committee reports the labor situation as becoming more critical as draft boards are put under more pressure to find men and as physical requirements are lowered. Nor could the committee recommend any general way in which to meet the situation. Importation of Mexican labor has helped in the Southwest, and in many regions high school boys have been employed to advantage. Some roads reported success in attracting and holding labor by increasing the hours of work, by providing better food and living conditions, and by transporting men to work.

Efforts being made by the federal government to help the railroads solve their labor problems were described by Donald Smith, assistant director, Bureau of Employment and Claims, Railroad Retirement Board, which agency is acting as a central employment service for the railroads under the supervision of the War Manpower Commission. Mr. Smith reported that Selective Service had taken 270,000 railway employees up to the end of 1943 and that 50,000 more will have gone by June.

Mr. Smith said that his board is seeking the help of Selective Service in minimizing the effect of its draft of labor on the railways. The board also passes on requests for release or transfer in all tight labor areas and so has been able to get a considerable number of men back into railroad service. Also, the board has impressed the seriousness of the railroad problem on

the WMC priority committees that are being set up in the tight labor areas.

In answer to a question about the reported use of war prisoners on railroads, Mr. Smith said that the War Manpower Commission's policy committee has not approved of such use of prisoners.

Use of Mexican labor

By agreement with Mexico, the ceil-on Mexican labor that can be imported into this country has been raised 20,000, making the total now 40,000. Mr. Smith said that Porto Rican and Jamaican labor had been tried on some Eastern Roads but that it was not as successful as Mexican labor.

Further details on the use of Mexican labor were given by T. A. Blair, assistant chief engineer of the Sante Fe System. Railroads in the Southwest have used Mexicans successfully for many years, he said, and many of their foremen speak Mexican. Men now being imported are allocated by representatives of the WMC in Mexico and are shipped to the border in Mexican railway equipment. A joint Mexican-American commission is now drawing up instructions as to conditions under which they can be worked. They cannot be used on districts where maintenance contractors are paying rates higher than that paid to railway labor. Ten percent of their pay is taken by the Mexican government and held until the men return to claim it in Mexico. Social Security and other taxes are not deducted.

Employers sign a bond to return the men to Mexico in 180 days. Mr. Blair said that the Sante Fe got 100 days work out of them last year but expects to get 150 this year. Most of this Mexican labor is used in extra gangs or in section gangs.

High-school boys engaged

Experience of the Milwaukee R. R. in using high-school boys was outlined by W. G. Powrie, engineer maintenance-of-way of that system. That railroad used 16- and 17-year-old boys in bridge crews, section gangs and extra gangs with considerable success. Last year it had 415 minors on the payroll, mostly in large extra gangs. School authorities cooperated with the railroad and for the larger gangs supplied teachers as monitors to help with personnel problems. It was found that the larger gangs needed more assistant foremen to supervise the work of the boys than are normally required in extra gangs.

Most boys accept responsibility quickly. Turnover and absenteeism was less than in normal gangs. Special attention had to be paid to safety training, and special provision had to be made for recreation in gangs located outside of the towns.

About 150 boys who worked in section gangs in summer have continued on a part-time basis since the opening of school. In a few instances schools have released these boys for emergency work such as snow fighting.

The Milwaukee expects to take on more boys this year but anticipates keener competition from industry. More will be done in the way of organized sports.

Scarce materials

Discussion of the situation with respect to materials for railroad maintenance was opened by A. C. Mann, director of the transportation equipment division of the WPB. In 1943, he said, the railroads had set their minimum rail requirements at 1,800,000 tons and had received 1,530,000 tons. For 1944 they have asked for 2,200,000 tons and have been allotted 1,825,000 tons. However, due to the improved steel situation, Mr. Mann said that it had found possible to add 40,000 tons to the first-quarter allotment and 100,000 tons to the second quarter. If this rate can be kept up, the 2,200,000 request can be met.

The situation with respect to crossties is not so bright, according to Mr. Mann. Railroads will have to cut their requirements to the bone and will have to accept whatever sizes and species of ties they can get. The WPB may have to put definite controls on ties as has been done with lumber.

There will be more of some types of maintenance equipment available this year than last, but this is being offset by efforts to get more equipment to replace labor. The WPB and ODT will attempt to allocate available equipment on the basis of need, hence all requests must be accompanied by detailed statements of the work for which it is to be used.

Possible economies

Ways on which requirements for track materials can be reduced were outlined by A. A. Miller, chief engineer, maintenance-of-way and structures of the Missouri Pacific Ry. Economic considerations, he said, must be forgotten for the time being. Ties can be turned over in some instances to add a year or two to their life and spikes can be reformed. Rail can be kept in service by building up battered ends. Short sections that are in bad shape should be replaced instead of renewing a whole stretch, as is customary. This also will reduce the number of the renewals that otherwise would be made.

Much ingenuity will be required bridge engineers, according to A. Wilson, engineer of bridges, easte region of the Pennsylvania, if they a to make the most of available materia Old bridges that normally would replaced can be strengthened to add few years to their life, and plain co crete can be used in many places wh standard practices call for reinforc concrete. Mr. Wilson laid special str on the importance of maintaining str tures in the best possible condition painting and repair. He called att tion to the recent A.R.E.A. bulletin bridge repair as a useful guide in th emergency bridge work.

Lumber can be conserved by sub tution of brick, tile or concrete for fra construction, according to A. L. Spark architect of the M-K-T lines, who al pointed out that a considerable amou of second hand lumber can be salvag from abandoned or little used buildin He recommended an organized sear for unused lumber similar to the scr metal drive.

Economies on material for water se ice have been found possible throu the salvage of unused pipe lines a through the cleaning of old lines to i crease their capacity, thus postpon replacement, according to A. B. Pier engineer of water service of the Southe Ry. Installation of automatic elect pumping equipment on the South made a considerable saving in coal, and manpower. The Southern chang its standard tank frames to permit t use of timber salvaged from old trest has substituted synthetic rubber natural rubber wherever possible, a has supplied its pump repair men w trucks to make them independent train service and thereby expanded t area that they can serve.

Anticipated new work

The Office of Defense Transporta will continue to approve such new c struction as is necessary to maintain integrity of the nation's railroad syst This statement was made by R. Groover of that office who had com the meeting when illness made it im sible for Joseph B. Eastman to carry his plan to be there. Mr. Eastm death was announced at the lunc meeting at which he had expected speak.

Last year the ODT approved over hundred million dollars worth of work. Approval of like amount year is anticipated.

Railroad men at war

The high spot of the meeting w talk by Lt. Col. Ralph E. Sherer, maintenance-of-way officer of the

(*Continued on page 74*)

ompetition restored on construction ccording to Truman committee

its third annual report to Congress the committee tells of its amination of contracts let for construction of war plants, and ds that competitive bidding did not prevent excessive profits.

al competition was restored in the ruction field during the past year, ding to the Truman committee's annual report to Congress con- g its investigation of the national se program. For this reason, the ittee states, it did not object to vision in the tax law that became ive Feb. 25 exempting competi- id contracts from renegotiation if uring the fiscal year beginning 1, 1943.

e committee declared that "so- d competitive bidding did not pre- excessive prices and excessive s" in 1942. It added that con- tion contractors should not be led aim exemptions for contracts sub- to the original law merely because Congress by the new law has ed them exemption for a later d.

e report includes a tabulation ing the results of 23 specific com- ive bid construction contracts re- iated by the Corps of Engineers to June 30, last year. The largest ese, a contract for $31,277,927, ed a gross job profit of $5,332,693 an indicated ratio of gross job prof- job costs of 20.55 percent before tiation. After negotiation, the ad- d gross job profits were $2,482,693 an adjusted ratio of gross job ts to adjusted job costs of 9.57 ent.

r the smallest job included in the lation, the contract price was $934,- with a gross profit of $139,441, and io of gross job profit to job costs .55 percent. After negotiation, the ted gross profit was $99,441, with djusted ratio of gross profit to ad- d profit of 12.51 percent.

Excess profit on many jobs

e report says that in submitting abulation to the committee, Briga- General McCoach informed the ittee that out of 234 construction actors to whom competitive bid ds were made, "excessive profits been found and agreed to by the actors in 102 cases, or 43.6 per- "

other tabulation included in the t shows profits for 50 companies did construction contract work e Navy. Not all of these contracts awarded on competitive bidding, eport says. Total gross contract earnings for the 50 companies were $110,274,356, with job costs of $84,204,145. Gross job profits amounted to $26,070,211, which is 31 percent of the job costs. The results in renegotiation were not supplied by the Navy.

• • •

U. S. 1944 construction to be almost $4 billion

Total construction activity in the United States during 1944 will amount to $3,700,000,000, it is estimated by the bureau of planning and statistics of the War Production Board. This is in comparison with $7,790,000,000 in 1940; $11,129,000,000 in 1941; $13,389,000,000 for 1942; and $7,560,000,000 in 1943. These figures are exclusive of machinery and equipment.

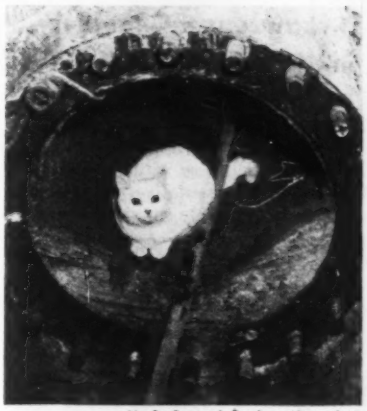
Of the $3,700,000,000 estimate, military construction is expected to take $840,000,000; government-financed industrial expansion $600,000,000; privately-financed industrial expansion $100,000,000; housing, other than military, $680,000,000; all other, $1,300,000,000.

The last amount is divided almost evenly between public and private construction. Public utilities construction is estimated at $35,000,000, and private at $480,000,000. Highway work is estimated at $365,000,000, and sewer and water projects at $85,000,000.

In addition to the $600,000,000 for government financed industrial construction, $950,000,000 worth of machinery and equipment is expected to be required. The greater part of the estimate for machinery and equipment is for the Defense Plant Corporation, with $790,000,000 of the $950,000,000 earmarked for that agency. Of the amount for actual construction, however, less than half will go into Defense Plant Corporation building.

Cumulative volume of construction, machinery, and equipment as of Jan. 31, 1944, was, for all types of government-financed war industrial facilities, $15,028,226,000, with $13,768,281,000 in place. These figures include plant expansion for the Army, the Navy and Bureau of Ships; shipways for the Navy's Bureau of Yards and Docks; and facilities for the Defense Plant Corporation, the Maritime Commission, and others. Of the scheduled amount, the largest figure, $6,670,560,000, is for the Defense Plant Corporation, and the smallest, $126,347,000, for aeronautics plant expansion for the Navy.

A summary of 1944 needs for construction materials, exclusive of overseas requirements, is as follows: Asphalt 1,265,000 tons, cast iron 359,000 tons, cement 66,338,000 bbl., copper 33,000 tons, lead 41,359 tons, lumber 6,646,000,000 bd. ft., steel 2,641,000 tons, zinc 10,309 tons.



U. S. Bur. of Reclamation photo

"Catpower" at Coulee

Although the Grand Coulee Dam, Wash., powerplant has available more than a million hp. of energy—second largest block of power in the world—Bureau of Reclamation workmen recently found it necessary to resort to the use of "catpower" in construction work on the project. To string 500 ft. of cable through a 24-in. winding drain pipe, the men tied a string to a cat and energized its movement through the pipe with the aid of a blast of compressed air. The string was then tied to a rope and a rope to the cable to complete the operation.

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Los Angeles employees win another $5 raise

The Los Angeles board of water and power commissioner recently granted another $5 monthly raise to 3,400 employees of the municipally-owned Department of Water and Power. This affects all workers earning $350 a month or less, and, coupled with a $5 raise in February, gives employees within $5 of the $15 increase demanded by them following their walkout in February. (ENR Mar. 2, p. 299.) This pay increase is a temporary measure pending a final report to be submitted by a three-man wage survey committee, and was recommended because of increased living costs.

E. Lawrence Chandler in Washington for A.S.C.E.

Effective March 1, E. Lawrence Chandler became assistant to the secretary of the American Society of Civil Engineers and is now with the Society's Washington representative. In that post he succeeds Hal Hale who is now executive secretary of the American Association of State Highway Officials. (*ENR* Dec. 23, 1943, p. 918).

Mr. Chandler started professional work in the sewerage and water supply

field in New England; spent five years with the Miami, Ohio, Conservancy District on heavy construction and for the next twelve years was engaged on steam and hydro-electric installations in the Middle West as superintendent for Price Brothers Co. of Dayton, Ohio.

In 1935 Mr. Chandler became chief engineer of the Chattanooga Flood Protection District. He has since worked on estimating and design for the Tennessee Valley Authority and as chief construction engineer on Pensacola Dam in Oklahoma. For the last three years Chandler has been with Chas. T. Main, Inc., of Boston, on shipyard work in Wilmington, Del., and on engineering investigation in South and Central America.

Offices of the A.S.C.E. inWashington are at 1026 Seventeenth St., N.W.

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Two engineers clubs in new quarters

The Engineers Club of Huntington, West Va., has established permanent quarters in the Hotel Governor Cabell. Members of engineers' clubs elsewhere are invited to use these quarters while in that city. The Huntington Engineers Club was organized in 1937 and has a membership of 125.

The Engineering Society of Cincinnati, Ohio, has just dedicated its new headquarters at McMillan Street and Woodburn Avenue, known as the Herman Schneider Foundation. This building was presented to local technical societies in honor of the late dean of the University of Cincinnati, who developed a system of cooperative education for engineering students.

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Move thirty houses by barge on Ohio River

On March 15 several large barges on the Ohio River were towed into the Louisville district from Point Pleasant, W. Va., on which were resting thirty small frame houses that were enroute to Camp Breckenridge, Ky., to relieve a civilian housing shortage. They were the first of 120 such units to be moved.

It was reported that this was the first project of its kind undertaken by the Government, through the National Housing Agency. Six or seven days are needed for the river trip and the houses will have to be trucked about five miles, after being removed from the barges. The units are complete with stove, electric refrigerator, etc.

Neighborgall & Leach, of Huntington, W. Va., who are moving the houses, also have a contract to build a 50-unit dormifory and a community building at the camp. The transported homes will be set up on the camp reservation in a 15-acre area. The project is costing $350,000.

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U. S. and Florida buy Davis Causeway

An agreement for Federal-State purchase of the Davis Causeway between Tampa and Clearwater, Fla., for $1,085,000 was executed March 10 and the span has been made toll free.

The 10-mile causeway, which cuts about seven miles off the distance between Clearwater and Tampa and avoids the numerous curves of the old route around old Tampa Bay, now becomes part of the State road system.

Negotiations are also under way for the purchase of Gandy Bridge between Tampa and St. Petersburg. Owners of the Gandy span have refused to accept the proffered Federal-State price and it is expected that condemnation proceedings will be instituted.

Government takes over canal at New Orleans

Operation of the locks in the Industrial Canal at New Orleans, La., will become toll-free on April 1 when the government takes over operation of the major portion of the canal, under lease from the New Orleans Dock Board. Federal operation of the locks will be on a 24-hr. basis instead of the present schedule of 16-hr. per day. This is of particular importance at the present time, according to Pendleton Lehde, president of the Lock Board, since every minute counts in the heavy wartime transportation of petroleum and other essential materials along the inland waterway. Making the locks toll-free will save at least $200,000 yearly to the commercial interests using the canal, said Mr. Lehde.

Under the new lease, renewable annually, the government will pay the Dock Board $240,000 a year in addition to maintaining the waterway. The lease covers the Industrial Canal from the forebay at the Mississippi River to the Rigolets—New Orleans link of the Intracoastal Canal. Included in this stretch are the locks which carry craft from the river level to the canal level. The set of locks in the Harvey Canal on the other side of the Mississippi River are already government owned.

Negotiations for the lease were made by Brig. Gen. Max C. Tyler, president Mississippi River Commission, representing the Corps of Engineers, U. S. Army.

• • •

Pa. Turnpike loses $3,000 daily but bonds are 105

According to information given the House Roads Committee on March 15 by John U. Shroyer, Pennsylvania secretary of highways, the famous Turnpike in that state—the 164-mile superhighway from Harrisburg to Pittsburgh—is losing $1,000 a day.

The reason given was gasoline rationing and the consequent great decline in motor vehicle traffic. The principal revenue now is from truck tolls, but the road gets no revenue from the government-owned trucks using the highway for the transportation of war products.

The Turnpike, which cost $75,000,000, is said to be potentially a profitable investment—when peace returns and unrestricted "pleasure driving" comes back again. Turnpike bonds reached a maximum quotation of $110 before the war. They were in the low eighties early in 1942 but now are quoted at $105.

Construction Communiques

Engineering news from the battlefronts

thern Burma—Not so many months Col. Lewis Pick, then U. S. Division Engineer at Omaha, Neb., was bragging about one of his area engineers who was really getting things done in a hurry. That man was Maj. Perley Lewis, who gave up his contracting business at Phoenix, Ariz., to join the Corps Engineers. Major Lewis had built the coln airbase in a hurry and then ped out to Sidney, Neb., on a big nance depot and cleaned that job up hort order.

Maj. Lewis

hese two are together again, accord- to a recent dispatch by A. T. Steele, he *Chicago Daily News*, this time in thern Burma. "We were sitting with Lewis Pick in his tent today, talk- about the Ledo Road," reports ele, "when Maj. Perley Lewis with d-pattered uniform, dismounted n his jeep and came in all excited. eveloped that all Lewis and his gang done was to push a trio of bull- ers through jungle trails to forward itions held by the Chinese Army and reby in the short space of 14 working rs, had converted a rice field clear- into a serviceable air strip."

teele goes on to say that Major Lewis ypical of the rugged outfit of Ameri- engineers who, for more than a year, e been digging their way through rmese mountains and jungles, in the eral direction of China, and who are ing so fast they are already close on heels of Lt. Gen. Stilwell's advancing nese army. He reports that several cers on the job came down from the an Highway and claim that project "a peanut job compared to the job utting the highway through the hills forests of the Burma-India frontier, re the annual rainfall exceeds 100 He also says, "Engineers, who are emotional men, still talk with rever- e of that day, little more than a th ago, when the first truck rolled r the mountains of India to this for- d base. They were loaded with beer ,600 cans. The celebration that en- d will go down in the history of Army ineers as an epochal event, and er was a celebration more richly ned."

Sea—In writing to S. Craig Cairns, of the Hobart Brothers Co., Troy, Ohio, George Chitarovich, with a Naval Construction Battalion somewhere in New Guinea, tells of an experience with welding repair while on the high seas. He said:

"On one occasion when 10 miles from shore, an 'incident' happened—well, anyway, a hole was blown in the side of our Navy LST. Since the hole was very rough and jagged, I first burnt out the hole to a 5-ft. square opening. I had counted on using some armor plate for the patch, but found that it was in the hold of the ship and impossible to get at. We carry pontoons on deck that are ¼ in. thick, so we cut up one of these pontoons to fit the square opening and then did a leak-proof job of welding with one of your welders that we carry on deck.

"After completing this much of the job, I suggested to the officer in charge that we weld another pontoon plate on the inside to reinforce the first plate, as with a heavier deck load the patch would be from 2 to 4 ft. below the water line. This second plate was welded under very tough conditions as the ship was heaving around from the swells. It was put on the inside because there was not much pressure on the plate itself, and I was anxious to do a neat job."

Canada—Canada will pay the United States for all permanent improvements of northwestern Canadian air routes, making them Canadian property.

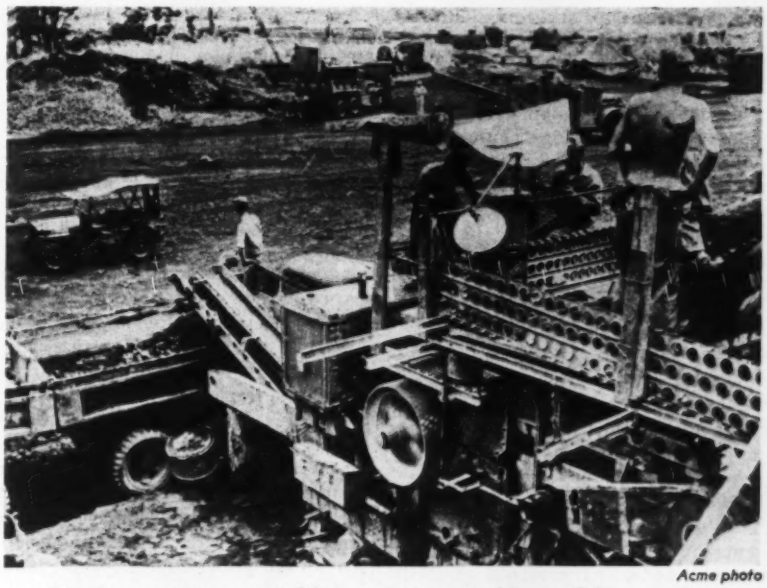
The total cost of the northwest staging route from Edmonton to Alaska to the end of 1943 is $46,000,000. The total cost of wartime development of N. W. Canadian airways is $58,500,000.

United States—Honoring the memory of two engineer war heroes, the large naval construction training center being completed at Quoddy Village, Me., has been named "Camp Lee-Stephenson."

The officers honored are: Lieut. Irwin W. Lee, who for 19 years was an engineer with the Illinois Division of Highways, and Lieut. George S. Stephenson. They were killed July 2, 1943, while with the Seabees in the Rendova Island offensive in the Southwest Pacific.

Dedication of the new camp will take place in the spring, according to word received from Secretary Knox by Mrs. Estelle Lee, the officer's widow. The official notification to Mrs. Lee read:

"This training center is one of our major continental construction battalion activities and is named in honor of your late husband and a fellow officer of the Civil Engineer Corps of the United States Naval Reserve, Lieut. George S. Stephenson, who was fatally wounded in the same action in which your husband gave his life for his country."



Acme photo

Rock crusher quickly set up at New Gloucester

After our Marines took from the Japs a strategic airfield of Cape Gloucester, New Britain, the Army Engineers quickly set up their rock-crushing equipment so that there was very little delay in providing material for hard surfacing. It was only a few days before the field was ready, and it has since been doing its part in making possible our many successful sorties against the enemy in that section of the southwest Pacific.

Activity on the Postwar Front

As the war continues, postwar plans are becoming more definite in many states and communities. Some of the latest developments in various sections are as follows:

Allegheny County, Pa.—The postwar program includes 43 projects, Park H. Martin, county planning engineer, has announced. The Department of Public Works and the Planning Commission are working jointly on a program representing $15,000,000 worth of construction work. Scheduled are four large and 40 minor bridges, 26 roads, two grade separations, two boulevards and an airport.

Connecticut—Douglas Orr, New Haven architect, has been appointed chairman of the committee on community development and housing of the Connecticut Post War Planning Board of which H. L. Craps is executive director. The committee will study industrial, population, transportation, and communication trends. It will look into natural resources, facilities for health, recreation, sanitation, and water supply.

The Hartford Metropolitan District Commission has announced plans for the postwar construction of a large dam and reservoir to impound the waters of the West Branch of the Farmington River in Hogback Gorge below Colebrook, Conn. The project will include a tunnel connection through a mountain and joining the proposed Hogback Reservoir with the Barkhamsted Reservoir, located on the east branch of the river.

Montana—The planning of 4-lane highways between Billings, Laurel, Butte and Anaconda as part of the postwar development of inter-regional highway systems has been announced by Howard W. Holmes, Montana state highway engineer.

San Francisco area—Seven East San Francisco Bay area cities, including Oakland and Berkeley, are considering a postwar sewage disposal project estimated to cost $8,386,000. Federal funds are expected to help finance the project.

Alabama—Postwar projects of Alabama municipalities include a $100,000 sewerage system at Lipscomb, a $70,000 addition to the water system at Piedmont, and a $100,000 addition to the water works and a $400,000 domestic gas system at Sylacauga.

North Carolina—The state Post War Planning Board has decided to set up permanent headquarters in the University of North Carolina's Institute of Government building at Chapel Hill and to employ a full-time secretary. It will give special attention to coordinating the postwar programs of municipalities, counties and institutions. Collier Cobb, Jr., construction contractor, is chairman.

Canada—Highway officials of the nine provinces met recently in Ottawa to draft a brief to the federal government asking it to establish a basis of federal aid in postwar highway building. It was pointed out that roadbuilding is one of the best methods of providing employment for war workers and veterans and that it is largely self-liquidating. Completion of the Trans-Canada highway was urged.

Riverside, Calif.—Postwar highway and bridge developments in Riverside County, Calif., costing about $2,250,400 have been approved by the board of supervisors. The program comprises 36 separate projects, and 165 miles of highway. About $1,000,000 is proposed for cross-city routes for fast traffic.

Illinois—The state reports postwar programs, for which detailed plans and specifications have been completed or are in preparation, totaling $121,368,700. Highway projects lead, at an estimated cost of $103,000,000.

Sixty-two of the 102 counties report projects totaling $96,028,689. Detailed plans and specifications are completed or in preparation for 46 percent of these, sketch plans are completed or in preparation for 28 percent, surveys are completed or in progress for 7 percent, leaving only 19 percent of the programs in the preliminary estimate stage.

Park districts, sanitary districts, and municipalities other than those in Chicago have reported projects totaling $93,812,569. Detailed plans and specifications are completed or in preparation for 22 percent of these, sketch plans are completed or in preparation for 29 percent, surveys are completed or in progress for 5 percent, leaving 44 percent in the preliminary estimate stage.

Michigan—The state highway department has announced that it has $96,000,000 worth of projects on its postwar list. It has put 24 survey crews to work gathering data for the final plans. Nearly 100 other men are at work drawing plans and preparing the details for construction.

Vancouver, B. C.—Blueprints are being prepared for the biggest public works program in the history of the city, according to H. L. Corey, chairman of the board of works. A special staff of field men is at work on detailed plans for the city's $25,000,000 postwar improvement scheme designed to serve the city adequately for the next 50 years.

Creation of a "distributor street" through the downtown area, and reconstruction of streets at the ends of Granville bridge to make way for a new $3,500,000 high-level, double-decked span are the chief tasks of the staff. The distributor street, a 120-ft. thoroughfare which will feed traffic into the downtown area, will cost approximately $2,500,000.

The field staff is also at work on plans for the development of new sewers, water mains, streets and widening of existing thoroughfares. The city's postwar plan has apportioned $4,000,000 for new sewers, $1,150,000 for new water mains, $3,330,000 for new pavements and $2,750,000 for street widening and reconstruction.

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Houston plans for future water system betterment

Houston, Tex., has cleared the way for financing its long-range $30,000,000 water improvement program by buying the last two outstanding bonds of its 1926 $1,500,000 water bond issue. Their repurchase by the city for $2,7[illegible] marks the successful completion of [illegible] year's campaign by City Controller W. H. Maunsell and City Manager John N. Edy to buy up at par and accrued interest the $480,000 worth of bonds outstanding. The campaign has cost Houston $588,000, but it removes a long standing legal obstacle to the expansion of the water department.

However, the $5,000,000 water improvement program slated for this year is all Houston can hope to accomplish in 1944 because of wartime construction restrictions, according to J. W. Nagle, city utilities director. Contract for the first work on this project was awarded J. Heffernan, Jr., on Feb. 2 for $69,354 worth of water mains, construction to start about April 1.

The $30,000,000 program is designed to meet Houston's water needs up to 1970. It is planned to spend $14,000,000 of this in the next three years to provide an adequate water supply from the San Jacinto River by using a dam, a canal system and new conduits.

WASHINGTON HIGHLIGHTS

The War Production board recently ithdrew the restriction that limited ilitary purchase of repair parts for ck-laying tractors to 40 percent of the llar value of the machine.

The War Production Board has pro- ed that no longer will owners of in- strial and commercial establishments issued blanket authorizations to carry miscellaneous routine construction r a fixed period. Exceptions are in es where filing of individual project plications would interfere with the r effort, or would cause extreme hard- p to the applicant. The board has o suspended until further notice gov- ing movements of portland cement. ub-committee of the Cement Industry visory Committee was set up to pro- te voluntary savings in cross hauling.

Establishment by the Office of Price dministration of two new basing points computing ceiling prices on eastern ruce, hemlock and white pine lumber expected to result in reductions in ice up to $3 per 1,000 bd. ft. The two w basing points are Cass, W. Va.; and ristol, Tenn. These are in addition to illiamsport, Pa., the point established eviously.

Practically all power cranes and ovels produced in 1944 will be needed the armed services, the War Produc- n Board reports. The majority of anufacturers are building only a few odels and sizes of standard products, d in general they are not able to meet livery schedules promptly. Civilian eds are filled for the most part from ed equipment. The inventory of used uipment (registered under order L- 6) lists approximately 25,000 cranes d shovels. However, not more than 10 rcent of the machines in good condi- n are idle at the present time, and ly part of this percentage is available r sale.

Charles E. Wilson, executive vice airman of the War Production Board, cently said that of 700,000 separate nds of items required for the North rica invasion, over 100,000 were for e Corps of Engineers, including erything from nails to bridges and comotives.

About 100 million bd. ft. of lumber is pected to be produced by a program anned to salvage timber damaged in eastern Texas and western Louisiana by a recent severe ice and sleet storm, according to Secretary of Agriculture Claude A. Wickard. The salvage program is to be carried out in about 400,000 acres around Lufkin, Tex., by a $3,000,000 loan of the Disaster Loan Corp. to the Federal Surplus Commodities Corp.

To hasten the production of airport construction machinery, the War Production Board has provided controls for the manufacture of large anti-friction ball bearings that go into such machinery. Besides naming authorized producers, WPB has announced that any other factory that previously made such bearings must keep its equipment in condition to be utilized within one month, if WPB so orders.

Other WPB action draws attention to Controlled Materials Plan Regulation No. 1, which provides for periodic checkup by consumers of allotments for controlled materials, to see whether or not they have more than they need.

The Office of Price Administration has put ceiling prices on yellow cyprus lumber used in sash and mill work, home construction and boat building. The ceiling prices are $6.00 per 1,000 bd. ft. higher than as of Oct. 1941.

MEN AND JOBS

Michael Baker, Jr., of The Baker Engineers, Rochester, Pa., whose civil engineering firm is now doing the engineering design and survey work on the $20,000,000 Penn - Lincoln Parkway in Pittsburgh, has been appointed chairman of the planning committee of the American Public Works Association.

In addition to his work on Pittsburgh's super-highway, Mr. Baker is directing an organization that has been engaged in various engineering capacities on construction projects valued in excess of $700,000,000 throughout the Western Hemisphere in the past three and one-half years.

Robert L. Whipple, Worcester contracting engineer, has been appointed associate commissioner, Massachusetts Department of Public Works, succeeding the late Charles E. Furnans.

W. N. Downey has been appointed engineer of bridges in charge of the bridge department of the Seaboard Air Line Railway. L. H. Hornsby is bridge engineer-maintenance at Norfolk, Va.

William R. Crowell, Cape Elizabeth, Me., formerly engineer for the Work Projects Administration and its last administrator at Portland, Me., has been named director of the War Manpower Commission in that area.

Ray Brayback, highway commissioner of Wood County, Wis., for more than 4 years, has resigned to accept a position in the sales organization of the Drott Tractor Co., Inc., of Milwaukee. He succeeds **Clarence Williams,** who is leaving for Louisville, Ky., where he will head his own company.

Division engineer for the Canadian National Railroad in Edmonton, Alberta, for the past 25 years, **R. W. Ross** has been appointed district engineer for the Province of Manitoba, with headquarters at Winnipeg.

Eugenio Rodriguez y Parra has assumed his duties as chief engineer of the National Railways of Mexico. He succeeds **Adrian del Paso,** who has another position with the railroad.

John P. Powers received a civil service appointment on March 1 as city engineer of Little Rock, Ark. He succeeds R. A. Boyce, who resigned to enter the employ of the Arkansas State Highway Commission. Since graduating from Little Rock College in 1923, Mr. Powers has been engaged in municipal, highway and building construction in Arkansas. For the past two years he served as engineer of construction for the Associated Architects of Little Rock.

W. G. Bester, Union County, Ia., engineer, has been granted a leave of absence to accept a Navy commission as lieutenant, j.g. **J. Bernard Russell,** former construction engineer for the county, has been appointed to replace him.

George W. Wood, former Ringgold County, Ia., engineer, has become Monroe County engineer, to succeed **Fred F. Tate.**

(*Continued on page* 130)

JOBS OF THE WEEK

EARTHWORK, Arizona and California

Bureau of Reclamation, Yuma, Ariz., awarded a contract for earthwork, concrete lining, and structures on the Coachella Canal, All-American Canal system, to J. F. Shea Co., Inc., Los Angeles, Calif., at $1,660,681.

BARRACKS and MESS HALL, Anacostia, D. C.

Ross Engineering Co., Washington, D. C., was the lowest bidder for constructing barracks and mess hall at Naval Training Center when Bureau of Yards & Docks, Navy Department, Washington, D. C., opened bids. The low offer was $973,180.

BARRACKS, Seattle, Wash.

Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded a contract for barracks to house enlisted men at Smith Cove Naval Station to Austin Co., Cleveland, O., at $3,774,000.

PULP MILLS, Kapuskasing, Ont.

Kimberley Clark Corp. of Canada, Toronto, Ont., has awarded a contract for the construction of two buildings for a crepe wadding mill to Hill-Clark-Francis, Ltd., New Liskeard, Ont. The estimated cost is $980,350.

AIRPORT EXCAVATION, Danville, Va.

Civil Aeronautics Administration, La Guardia Field, Jackson Heights, N. Y., awarded a contract for grading at municipal airport to Mecklenburg Construction Co., Durham, N. C., $508,463, also for asphalt paving to F. D. Cline, Raleigh, $702,660.

AIRPORT IMPROVEMENTS, El Toro, Calif.

Macco Construction Co., Clearwater, Calif., has been awarded a contract for grading and paving runways and paving areas and field lighting at Marine Corps Air Station, by Bureau of Yards & Docks, Navy Department, Washington, D. C., at $1,398,136.

WAREHOUSES, El Centro, Calif.

M. N. Sundt, Tucson, has been awarded a contract for constructing warehouses at Marine Corps Air Station, by Bureau of Yards & Docks, Navy Department, Washington, D. C., at $2,118,000.

BARRACKS, Mess Facilities, at Yerba Buena Island, Calif.

Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded a contract for barracks and mess facilities at Receiving Ship, to Dinwiddie Construction Co., San Francisco, at $917,900.

AIRPLANE PLANT, Muskegon, Mich.

Continental Aviation & Engineering Corp., Muskegon, Mich., awarded a contract for brick, steel airplane plant addition to J. A. Utley Co., Royal Oak, Mich. The estimated cost is $2,400,000.

HOUSING, San Francisco, Calif.

Housing Authority of the City and County of San Francisco, awarded a contract for constructing 528 dwellings at Army and Vermont Sts., to MacDonald & Kahn, Inc., San Francisco, at $995,300. E. Geoffrey Bangs and Ernest E. Weihe, San Francisco, are the architects.

AIRPORT, Knoxville, Tenn.

Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded a contract for the construction of airport improvements at McGee-Tyson Airport, to Pittman Construction Co., Atlanta, Ga., at $1,221,000.

PLANT, Muskegon, Mich.

Defense Plant Corp., Washington, D. C., has awarded a contract to Kaiser-Ducett Co., Chicago, Ill., for the construction of new plant buildings and remodeling old ones, at an estimated cost of $1,000,000. Campbell, Wyant & Cannon Foundry, Muskegon, are the operators.

HOUSING, Los Angeles, Calif.

Public Housing Authority, San Francisco, Calif., awarded a contract for prefabricated units to Modulock, Inc., Baltimore, Md., Shoemaker & Evans, Phoenix, Ariz., and Northwest Fabricators, Boise, Idaho. The estimated cost is $2,878,000.

Note—Additional bidding and contract news on many projects large and small appear in the Construction News section beginning on page 173.

A.R.E.A. considers labor and materials

(*Continued from page 68*)

quarters staff of the Military Railway Service in the European Theatre of Operations, who recently returned from Italy and Africa. For security reasons Colonel Sherer confined his talk to the experiences of our railway battalions in North Africa. Those battalions consist of four companies, a headquarters company, a maintenance and signal company, shop company and an operating company. Ordinarily, restoration of damaged rail lines is a function of the Corps of Engineers, but in North Africa much of that work was done by maintenance companies of the Military Railway Service in cooperation with the British, and subsequently with the French.

In North Africa

Destruction of rail lines in North Africa was not done with the efficiency generally credited to the Germans, Col. Sherer said, but the Germans were prolific in their use of land mines and anti-personnel mines.

In replacing large wrecked bridges a common practice was to build a short "deviation" around the bridge, generally about a mile long, crossing the streambed on a fill over wood-box culverts designed to carry the low water flow. In some instances unseasonable rains caused washouts in these fills before the permanent bridge had been rebuilt.

Commenting briefly on Italy, Col. Sherer said that rehabilitation of rail lines there was under the direction of General Carl R. Gray, head of the Military Railway Service, and that the Germans were more thorough in their demolition in Italy then they had been in North Africa.

New officers

F. R. Layng, chief engineer of the Bessemer and Lake Erie R.R. was elected president to succeed H. R. Clarke, who has served for two years due to abandonment of last year's meeting. No other president has served two years since the early days of the association. A. A. Miller, chief engineer, maintenance-of-way, Missouri Pacific R.R., succeeds Mr. Layng as first vice president, and T. B. Akers, assistant chief engineer of the Southern was elected second vice president. New directors are J. E. Teal, transportation engineer of the C. & O., W. H. Penfield, chief engineer of the Milwaukee, and C. H. Mottier, chief engineer of the Illinois Central.

Notes on the committee reports will be published in one of our subsequent issues.

OBITUARY

Julius E. Willoughby, 72, consulting engineer and formerly chief engineer of the Atlantic Coast Line Ry., Wilmington, N. C., died March 11 at Sarasota, Fla.

John A. Poteat, 45, resident engineer, Marion, N. C., for 5th District, North Carolina State Highway and Public Works Commission, died March 12. He had been with the state highway department 22 years.

E. M. Allen, Sr., 64, veteran Kentucky road contractor, and partner in the firm of Allen-Codell, Winchester, died March 7. He became a partner of the Winchester company six years ago. Previously he operated his own business for twenty-four years, building roads in Kentucky, Louisiana and Florida.

Earle L. Neville, 46, chief engineer with Foley Bros., Inc., contractors at St. Paul, Minn., and a resident of Wahtomedi, Minn., died March 4.

John J. Gagan, 54, formerly superintendent of the Framingham, Mass., public works department, died March 5. Mr. Gagan had been connected with the department for 25 years.

Earl R. Whitmore, 62, city engineer of Port Huron, Mich., died March 9 in Lansing.

Charles E. Furnans, 48, South Dartmouth, Mass., associate commissioner of the Massachusetts public works commission, died Feb. 24. In the first World War Mr. Furnans was an engineer in the U. S. Navy.

Fred Hohloch, 68, contractor and builder for more than 40 years, died March 11 in Youngstown, Ohio. His firm helped build many of the city's largest buildings and industrial plants.

Ben H. Flynn, 54, inventor, contractor, and manufacturer, died Feb. 22 at Alexandria, La. For many years he was active in construction work, chiefly concrete paving, in Oklahoma, Texas and Louisiana.

Thomas Emmet Leahy, 67, a civil engineer who retired in 1942, died March 9 in Canton, Ohio. He supervised construction of several large government buildings. After the first World War he was engaged in converting army barracks into hospitals for veterans. In 1928 and for five years he was supervising engineer for the Barksdale, La., airfield. Thence he went to Texas to construct other air fields until 1941, when he went to Columbus, Ohio, and was in charge of construction of a storage depot for the Army Ordnance Department.

M. J. Gallagher, 87, contractor and builder in Memphis, Tenn., for 45 years, died March 12. A native of Canada, he entered the building trade at Chicago, later went west and erected many structures in San Francisco, Seattle and British Columbia. In Memphis he built many of the prominent warehouses.

Thomas W. Keller, 55, Covington, Ky., died March 12. He built Dix Dam, near Harrodsburg, Ky., the Mundelein Railway for the Eucharist Congress in Chicago, 1930, and Camp Sevier, N. C., during the first World War.

William Sidney Wolfe, 54, chief engineer for Smith, Hinchman and Grylls, architects and engineers, of Detroit, Mich., died Feb. 10. He studied at the University of Illinois, receiving his degree in 1914. He remained to teach graphical statics and other engineering subjects, and to work on his book, "Graphical Analysis." As a structural engineer, his work is in evidence in important skyscrapers and industrial plants He aided and inspired hundreds of young engineers.

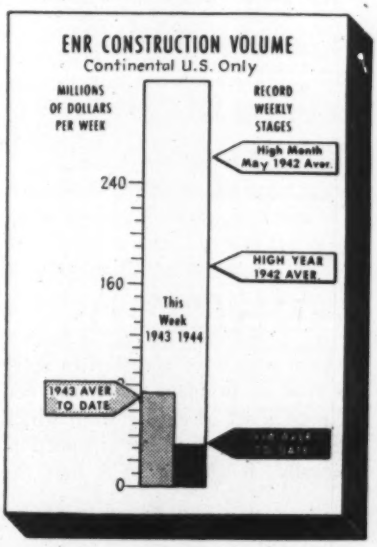
News of the Week
Continued on p. 125

CONTRACTS AND CAPITAL

CIVIL ENGINEERING construction volume in continental U. S. totals $32,909,000 for the week. This volume, not including the construction by military engineers abroad, American contracts outside the country, and shipbuilding, is 12 percent higher than in the preceding week, but 56 percent lower than in the corresponding 1943 week.

Public construction is 18 percent above last week as a result of the 23 percent gain in federal work, and is responsible for the increase over a week ago, as private work is 25 percent lower. Compared with the 1943 week, however, public is down 49 percent, and private construction is down 79 percent.

The current week's construction brings 1944 volume to $420,710,000 for the twelve weeks, a decrease of 50 percent from the $839,041,000 reported for the period in 1943. Private construction, $88,090,000, is 7 percent above last year, but public work, $332,620,000, is down 56 percent due to the 59 percent decline in federal work.



In the classified construction groups, gains over last week are in bridges, commercial and public buildings, earthwork and drainage, and unclassified construction. Earthwork and drainage is the only class of work to gain over the 1943 week.

New capital for construction purposes for the week totals $2,044,000, a decrease of 40 percent from the volume for the week last year. The week's new financing is made up of $2,000,000 in corporate security issues, and $44,000 in state and municipal bond sales. New construction financing for 1944 to date, $177,233,000, is 183 percent above the $62,718,000 for the twelve weeks of 1943.

CONTRACTS
Continental U. S. Only
(Thousand of Dollars)

	Week Ending Mar. 25 1943	Mar. 16 1944	Mar. 23 1944
Federal	$54,069	$22,237	$27,374
State & Municipal	4,356	2,874	2,299
Total public.	$58,425	$25,111	$29,673
Total private	15,705	4,304	3,236
TOTAL	$74,130	$29,415	$32,909
Cumulative 1944 (12 weeks)			$420,710
1943 (12 weeks)			$839,041

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	1943 12 weeks	Cumulative 1944 12 weeks
NON-FEDERAL	$62,718	$86,401
Corp. Securities	1,250	53,176
State & Mun.	56,880	27,450
RFC Loans	1,500	5,775
FPHA Loans	3,088	....
FEDERAL	....	$90,832
TOTAL CAPITAL	$62,718	$177,233

ENR INDEX NUMBERS

Index base=100		1913	1926
Construction Cost.	Mar. '44	295.34	141.97
Building Cost	Mar. '44	232.32	125.59
Volume	Feb. '44	86.	38.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Stresses in Anchors

Sir: The article by William I. Powell, "Stresses in Anchors for Wall Brackets," (*ENR*, Nov. 18, 1943, p. 760) calls attention to a subject which has been conspicuous by its absence from published engineering literature. The writer hopes that the article will serve as the occasion for a full discussion of the subject.

In his studies of suspension bridge tower anchorages, the writer has used the method described by the author but in a somewhat different form. This form is given below with the thought that some may find it slightly more convenient to apply.

Except where additional symbols are noted and defined, the author's nomenclature is used. For example:

M_{cc} = Moment of compression wedge about neutral axis

$$M_{cc} = (by - A_b)\frac{S_c y}{3}$$

M_{st} = Resisting moment of bolt tensions about neutral axis

Find M_{st} in terms of S_c and y

Let:

e_n = Elongation of bolts at x_n from neutral axis

A_n = Total area of bolts at x_n from neutral axis

S_{tn} = Unit tensile stress in bolts at x_n from neutral axis

r = Total number of rows of bolts in tension

L_s = Effective length of bolts

L_c = Effective length of material in compression

Then, by the usual straight-line assumption for distribution of deformation in fibers of a beam:

$$e_n = x_n \frac{e}{y}$$

Also

$$e_n = \frac{S_{tn} L_s}{E_s}$$

And

$$e_c = \frac{S_c L_c}{E_c}$$

Therefore,

$$\frac{S_{tn} L_s}{E_s} = \frac{x_n}{y}\frac{S_c L_c}{E_c}$$

Now assuming $L_s = L_c$, as implied in the author's treatment

$$S_{tn} = \frac{x_n}{y}\frac{S_c E_s}{E_c}$$

Since

$$M_{st} = \Sigma^r_n S_{tn} A_n x_n$$

Therefore,

$$M_{st} = \frac{S_c}{y}\frac{E_s}{E_c}\Sigma^r_n A_n x^2_n$$

Equating moments

$$Pl = M_{cc} + M_{st}$$

$$= (by - A_b)\frac{S_c y}{3} + \frac{S_c E_s}{y E_c}\Sigma^r_n A_n x^2_n \quad (1)$$

Equating forces parallel to bolts:

$$(by - A_b)\frac{S_c}{2} = \frac{S_c E_s}{y E_c}\Sigma^r_n A_n x_n$$

or

$$\frac{by - A_b}{2} = \frac{E_s}{y E_c}\Sigma^r_n A_n x_n \quad (2)$$

Let $K_n = x_n + y$ = a known value

Then $x_n = K_n - y$

Substitute in Eq's. (1) & (2)

$$Pl = (by - A_b)\frac{S_c y}{3} + \frac{S_c E_s}{y E_c}\Sigma^r_n A_n (K_n - y)^2 \quad (3)$$

$$\frac{by - A_b}{2} = \frac{E_s}{y E_c}\Sigma^r_n A_n (K_n - y) \quad (4)$$

Find y from Eq. (4) and then S_c from Eq. (3).

Usually A_b may be disregarded, and Eq. (4) may be simplified as follows:

$$by^2 = \frac{2 E_s}{E_c}\Sigma^r_n A_n K_n - \frac{2 E_s y}{E_c}\Sigma^r_n A_n \quad (5)$$

Let:

$d = \frac{1}{2}$ of base length, or distance from edge of bearing to center of bolt group

$\overline{K}$ = distance from compression edge of base to centroid of tension steel area

$$p = \frac{\Sigma^r_n A_n}{bd}$$

Multiply through Eq. (5) by

$$\frac{d}{\Sigma^r_n A_n}$$

$$\frac{y^2}{p} = \frac{2d E_s}{E_c}\overline{K} - \frac{2d E_s}{E_c}y$$

Solve for $\frac{y}{d}$:

$$\frac{y}{d} = p\frac{E_s}{E_c}\left[\sqrt{\left(\frac{2 E_c \overline{K}}{p E_s d} + 1\right)} - 1\right] \quad (6)$$

Those who have occasion to solve this type of problem frequently can make up a set of curves from which y may be obtained by inspection. Generally, it can be said that the minimum limit of $\frac{\overline{K}}{d}$ is 1 and the maximum limit is 2. Therefore, find a separate curve for each of any desired number of values of $\frac{\overline{K}}{d}$ between 1 and 2. Construct each curve by plotting $\frac{y}{d}$ against p. One point on each curve should represent the value of p for $\frac{y}{d} = 1$. If each curve includes values of p ranging .03 or .04 on both sides of this point, the chart should cover most problems in practice.

This is just one of many approximate methods that may be used to reach a practical solution of this type of problem. Undoubtedly every engineering office has its own pet method, and it would be to the advantage of the profession if the method which contains the best combination of practicability and sufficient accuracy could be generally adopted.

BLAIR BIRDSALL
Ass't. Chief Engr., Bridge Department
John A. Roebling's Sons Co.

Influence Line Computations

Sir: The article by Prof. C. J. Posey, "Computations for Influence Lines Simplified by Semi-Graphical Method," appearing in *Engineering News-Record*, Dec. 16, 1943, p. 911, was of extreme interest. Although the application of the Muller-Breslau principle is nothing new for influence line computation, the semi-graphical procedure given by the author is rather novel and worth while. It is definitely advantageous for plotting deflections caused by a linear variation in the moment.

It is apparent that, if the quantitative influence line is desired for some particular point, the method shown will save much of the time and labor that would be required by the more obvious method of moving a unit load across the structure. However, when quantitative influence lines are used for design or analysis purposes, they are needed at each floor beam or panel point. To obtain a complete set of influence lines for moment for the three-span continuous beam illustrated in the article, the procedure would have to be repeated about twenty times—once for each point where the influence line is required. But this involves as much work, if not more, than by simply placing a unit load at each of the points and computing the moments directly.

It seems paradoxical that a method advantageous for a single application should lose so much of its value when it is applied repeatedly in the same structure.

Some of the labor in finding the "indeterminate moment" may be eliminated by utilizing the end rotation constant in distributing the "fixed-end moment," in the example given M_4 equals

$$\frac{65 \times 0.857}{35 \times 0.75 + 65 \times 0.857} \times (70.9) \text{ or } +34.1.$$

Or, if the equivalent elastic properties of the adjoining spans are included, the "indeterminate moment" may be ascertained directly by the column analogy without having to find the "fixed-end moment." Thus, M_4 equals

$$\frac{1 \times 60 \times 65}{0.692 \times (65)^2} = 0.0205$$

(The tangent intercept is equal to $\frac{0.0205\ (65)^2}{6 \times 1}$; or 14.4, where $EI = 1$).

M. W. ROSENSTEIN,
5513 Everett Ave., Chicago, Ill.

Earthwork Computations

Sir: With reference to Mr. Aziel Lafave's article "Earthwork Computations by use of a Mechanical Calculator," in *Engineering News-Record*, Feb. 10, 1944, p. 197. The following comments are offered to simplify calculation and avoid a negative answer, which requires an additional mental calculation and affords chance for error.

Using Mr. Lafave's illustration, which is reproduced on this page, place numerals 94 over 0 at Point *C*, and 92 over 0 at Point *D*. Correct point *A* to 108 over *0*.

To find double area of *CDFE:*

(1) Set off decimals in keyboard, middle, and upper dials. With a clear keyboard, run upper dial to El. 92.0, the elevation of Point *D*.

(2) Mentally add 0 (at *D*) to 40 (at *F*), place 40 in the keyboard, and run upper dial to El. 92.0 (at *F*). Since there is no change in elevation, but is the upper dial already reads 00, the keyboard is cleared. (This step is mentioned to bring out the normal procedure if there had been a change in elevation at Point *F*).

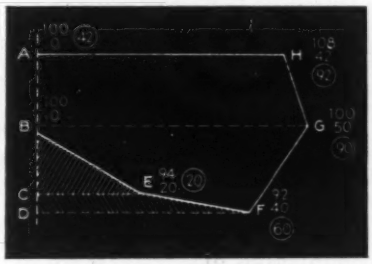
(3) Mentally add 40 (at *F*) to 20 (at *E*), place 60 in the keyboard, run upper dial to El. 94.0 (at *E*), and clear keyboard.

(4) Mentally add 20 (at *E*) to 0 (at *C*), place 20 in the keyboard, and run upper dial to El. 94.0 (there is no change in elevation so keyboard is cleared). Finally read double area (120.0 sq. ft.) on middle dial.

To find double area of *BCE:*

Start at *C*, El. 94.0, which is still in upper dial.

(1) Mentally add 0 (at *C*) to 20 (at *E*). However, there is no change



End section for illustrating earthwork computations with calculator

in elevation from *C* to *E*, so mentally add 20 (at *E*) to 0 (at *C*), place 20 in keyboard, and run upper dial to El. 100.0 (at *B*). Finally, clear keyboard and read cumulative double area (240.0 sq. ft.) of *BCE* and *CDFE* on middle dial.

To find double area of *BEFG:*

(1) Set upper dial at El. 100.0 (at *B*), add 0 (at *B*) to 20 (at *E*), place 20 in keyboard, run upper dial to El. 94.0 (at *E*), clear keyboard, mentally add 20 (at *E*) to 40 (at *F*), place 60 in keyboard, run upper dial to El.92.0 (at *F*), clear keyboard, add 40 (at *F*) to 50 (at *G*), place 90 in keyboard and run upper dial to El. 100.0 (at *G*), and clear keyboard. There is no change in elevation from *G* to *B*, so read cumulative double area (720.0 sq. ft.) of *CDFE*, *BCE* and *BEFG* on middle dial.

(1) Set upper dial at El. 100.0 (at *B*), add 0 (at *B*) to 20 (at *E*), place 20 in keyboard, run upper dial to El. 94.0 (at *E*), clear keyboard, mentally add 20 (at *E*) to 40 (at *F*), place 60 in keyboard, run upper dial to El. 92.0 (at *F*), clear keyboard, add 40 at (*F*) to 50 (at *G*). Place 90 in keyboard and run upper dial to elevation 100.0 (at *G*), clear keyboard. There is no change in elevation from *G* to *B*, so read cumulative double area (720.0 sq. ft.) of *CDFE*, *BCE* and *BEFG* on middle dial.

To find double area of *ABGH* start at *B* and run counter-clockwise to *A*. Read cumulative double area (1,456.0 sq. ft.) of *CDRE*, *BCE*, *BEFG* and *ABGH* on middle dial.

If the object is to secure the double area of the Figure *ABEFGHA* alone, start at *B* and run around the section counter-clockwise to *A*, reading the double area (1216.0 sq. ft.) on middle dial.

The sections may be checked by using the elevations as distances and distances as elevations, and using the procedure outlined. Always go under, then over the section to avoid negative answers, or the complement of the answer.

The section computations may be started at any reference point on the section, using the distances given, and adding the distance at the point under calculation to the previous point, that is, if a section shows fill for say 15 ft. both sides of center line and then shows excavation. Separate computation of the excavation may be made without referring distances to 0 at 15 ft.

This method was first used by the writer some fourteen years ago when making final highway earthwork estimates for the Louisiana Highway Commission. The information was given out as a mimeographed bulletin by Mr. H. S. Allen, chief engineering auditor and was titled "Method of Computing Areas where Elevations are given," by A. C. Cooper.

The writer has evolved a system where this method can be used to advantage in figuring irregular sections by the hand method by merely diagnosing and duplicating the operations of the calculator. This method is more simple than the point method shown in most reference manuals. The work to find the area of *ABEFGHA* by this method is as follows:

Sta.	Distance	×	Elev. Diff. (Plus or Minus with reference to previous point)	=	Double Area Minus	Double Area Plus
B to *E*	(0+20)=20	×	−6	=	−120	
E to *F*	(20+40)=60	×	−2	=	−120	
F to *G*	(40+50)=90	×	+8	=		+720
G to *H*	(50+42)=92	×	+8	=		+736
H to *A*	(42+ 0)=42	×	0	=		0
					−240	+1,456
						−240

Double area desired = 1,216 sq.ft.

The foregoing is offered as constructive criticism, and amplification of Mr. Lafave's article.

HAROLD O. MARQUART,
Construction Engineer, Pipe Dept., Aluminum Co. of America, Baton Rouge, La.

EDITORIALS

VOLUME 132 NUMBER 12

March 23, 1944

From Slogan to Reality

GRATIFYING PROGRESS is being made in postwar planning of water supply projects, as is revealed by a comparison of recent statistics. Elsewhere in this issue there is a summary of findings by the U. S. Public Health Service showing that the overall *need* for water-supply facilities in this country totals about $683,000,000. This, then, establishes a desired objective against which to measure current accomplishments in postwar plan preparation. Over the past two decades the average yearly expenditure for water supply, according to the compilations of *Engineering News-Record*, has been about $84,000,000. Thus, on the basis of past performance it should take about eight years of normal activity to realize the goal ahead. But the postwar challenge is to prepare projects so that a large volume of work can be undertaken immediately following the cessation of hostilities or when unemployment rises. Are water-supply projects being readied for this purpose? The answer is yes. Latest statistics show that already $240,000,000 of proposed work has been reported to *Engineering News-Record*, and of this total, plans and designs are underway on $60,000,000 of work. Not only is almost an average year of work being blueprinted now, but four times this amount is scheduled for such action. Here is clear evidence of the aggressive, intelligent promotion activities of the Committee on Water and Sewage Works Development. The committee is to be congratulated on its efforts, and should find satisfaction in knowing that "Blueprint Now" is no longer a slogan but a reality.

Pavement Salvage

ENGINEERS of the Missouri Highway Department are extending the useful life of disintegrating concrete pavements by forcing a soil-cement slurry under the broken slab ends where "pumping" occurs, followed by resurfacing with bituminous concrete. The main objectives are to eliminate the "free" water under the old concrete slabs that produces the destructive pumping, replace soil lost by the pumping action, and seal the pavement against future penetration of surface water to the subgrade. No effort is made to raise the pavement to a uniform grade, but local irregularities are corrected to give a smooth riding surface as that reduces the destructive effect of traffic, which now is heavier than that for which the pavements were designed. This salvage program is designed to keep old pavements in service until they can be replaced. Its success and low cost commend it to other highway departments with like problems.

Concrete in Small Structures

CONCRETE FOR THE SMALLER JOB seems definitely on the way to improvement as a result of the recent revisions of the specifications of the American Concrete Institute for structures requiring cement in small quantities. These specifications are the outcome of a conclusion reached by many concerned with concrete mix design that concrete design has become too complicated for the personnel and control equipment that will be placed on small jobs. In furtherance of trend toward better concrete on small jobs there is outlined in this issue a method under which proportioning concrete requires only four simple charts and a set of screens. With this equipment it is possible to produce a workable mix from unknown aggregates without a lengthy series of tests. Application of such readily understandable concrete-control methods to small jobs should pay large dividends, for concrete in small structures often is more exposed to attack than is that in large structures where control has long been exercised.

Those Big Trucks

ONE OF THESE DAYS the country is going to get a great surprise when the figures are released on the number of heavy trucks that the Army ordered last year. It is rumored that the initial astronomical orders were cut, but even so the current program is said to be unprecedented in size. No doubt some of the trucks will still be in this country when the war ends. Will they be too heavy to be used on our highways without serious damage to the pavements? At the present time many existing trucks are being overloaded on the plea of war necessity, and a fight is in store for highway engineers before we get back to sensible peacetime load concentrations. How much more difficult that will be if these new Army "heavies" are out of bounds in the way their wheel loads are distributed! The question is raised now because highway engineers should begin thinking of possible solutions for what may be a serious postwar problem. Certainly, the truck operating companies are going to fight to retain the advantage they have gained under the wartime lifting of state

strictions. Their efforts must be countered by ersuasive arguments on the part of highway offi- ls if continuing damage to existing pavements is be avoided.

Vicious Attack on the TVA

NEW ATTACK has been launched in Congress ainst the Tennessee Valley Authority that is of ncern to all who wish to see engineers and their rk kept free of political control. Riders attached the Independent Offices Appropriations Bill uld require Senate confirmation of the appoint- nt of all TVA employees earning $4,500 or over d would require the TVA to turn all its revenues o the general fund of the U. S. Treasury. This er proposal would make it necessary for the A to go to Congress each year for funds with ich to maintain and operate its power facilities. Senate confirmation of appointment of the higher aried positions in the TVA obviously would an that the appointees must be politically ceptable to those in command of federal patron- in Tennessee. That would inevitably tend to er the high quality of the engineering that up to has characterized the TVA. Heretofore the qualifications that were demanded of engineers aged by the TVA was evidence of ability in their cial field of endeavor and sympathy with the lared objectives of the Tennessee Valley Author- Addition of a political qualification is sure to ve away engineers with the ability that is neces- y to the continued success of the undertaking. Similarly, a requirement that the TVA turn its ome into the federal treasury and apply to Con- ss each year for funds with which to operate is trary to sound business principles. Regardless one's views on the question of private *vs* public er development, it is obvious that that con- ersial issue can only be confused and made a ater football of politics by a system that would TVA income and expenditures into the general of federal funds. The men who have under- n the task of demonstrating what can be done a properly integrated system of publicly owned tric utilities should be given complete inde- dence in their accounting of receipts and expen- res. Similarly, those who would challenge their figures should not be required to untangle them a mass of unrelated federal expenditures.

This country now has the TVA for better or for worse. To date the record is one of which the employees from top to bottom may well be proud. The practical problems of operating an electric utility system efficiently have given David E. Lilienthal and his staff an appreciation of the problems of the private utility operators that bids fair to do much to reduce the gulf between the proponents of private and publicly owned electric utilities. Those men are now in a position to give the nation sound advice as to the problems and pitfalls of other public power development schemes that doubtless will be put forward after the war. Congress should do nothing to lower their morale or reduce the efficiency of their operations. The riders to the Independent Offices Appropriations Bill that relate to the TVA should be killed.

Wartime Bridge Remodeling

CONVERSION OF 19 BRIDGES over Chicago's Sanitary and Ship Canal into movable bridges has been completed, thus making it possible for war vessels built on the Great Lakes to move down the Mississippi River waterway system to the Gulf. Speed in construction was supplemented by resourcefulness and ingenuity, as will be seen in the account in this issue of work on the South Western Avenue Bridge, largest and most difficult task in the group. That was a fixed bridge which had to be converted into a lift structure; others had been designed as movable bridges but had never been completely equipped for operations.

Whether bridges over inland waterways used chiefly by barge traffic should be movable structures has been a controversial question for many years. Railroad companies, which have borne the brunt of the cost of building such structures, have long opposed their construction as unjustified economically. Their arguments find mute support in the many costly lift spans along their lines that seldom if ever are opened. Doubtless the question is one that cannot be answered categorically. This much, however, appears evident; bridges over such waterways should be designed so that they can be converted into movable spans should that become necessary. The cost of the bridges would not be greatly increased, and such a provision would make unnecessary the expedients that were required along the Chicago waterway.

INEERING NEWS-RECORD WALDO G. BOWMAN, *Editor* **Copyright, 1944, by McGraw-Hill Publishing Company, Inc.**
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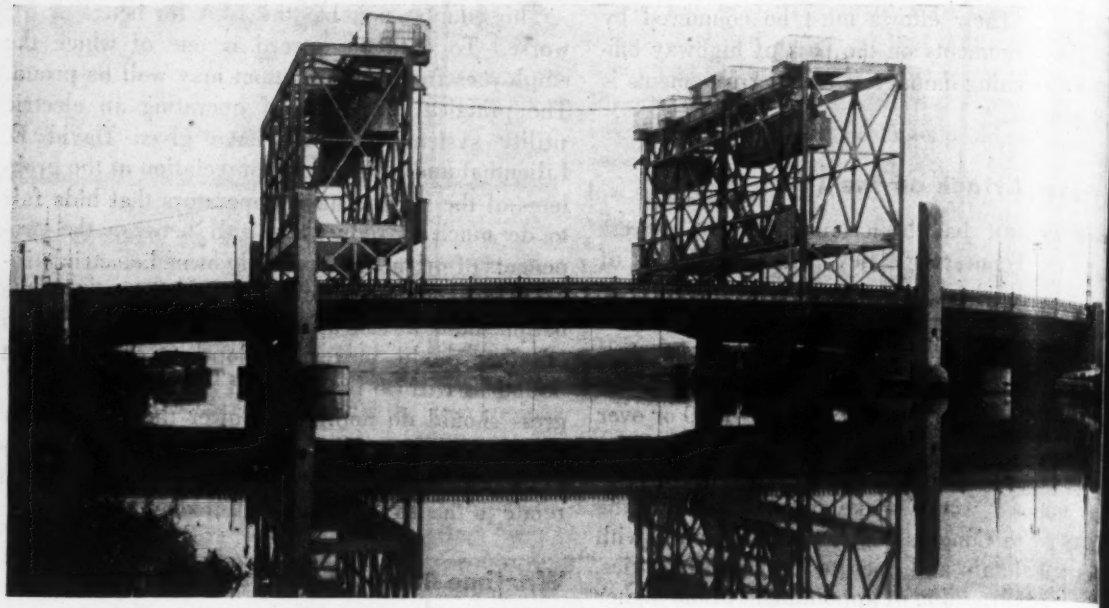


Fig. 1. Ten-lane fixed bridge in Chicago made into a lift span to pass war craft from the Great Lakes to the Gulf.

Fixed Bridge Converted to Lift Span

Stephen J. Michuda
Engineer of Bridges, City of Chicago

***Contents in Brief**—Navigation of war craft on the Great Lakes-to-Gulf waterway was made possible by remodeling Chicago's ten-lane fixed bridge into a 28-ft. vertical lift bridge. Converting such a heavy structure without interrupting street or river traffic required carefully planned construction. Despite severe winter weather, alterations were rushed to completion on this, the largest of 19 bridges over the Sanitary and Ship Canal recently rehabilitated under Navy contracts to pass large vessels.*

CONVERSION of the ten-lane South Western Avenue fixed bridge into a lift bridge over the Sanitary and Ship Canal in Chicago is a story of America's will to win; a construction story of a relentless fight against time and the elements. As a fixed bridge, its 21-ft. vertical clearance over the canal was inadequate to permit passage of war craft from Great Lakes shipyards to the Gulf of Mexico via the Illinois and Mississippi rivers, a route which offered many advantages. True, some vessels had been taken through by omitting their superstructures and lowering the canal four feet, but this method had serious drawbacks.

Design studies were initiated shortly before Pearl Harbor when the need for an early modification of this structure first became apparent. By July, 1942, the city had completed plans and specifications and had c summated a contract with the N Department for the alteration to done by the city. Bids were rece August 12, contracts were awar and orders for materials placed. F shipment of steel for the towers rived at the site January 22. Dur the next ten weeks, in one of cago's coldest winters, the steel ers, huge sheaves, carrying cables lifting trusses were erected, conc counterweights were poured, mach ery and electrical equipment c pleted to the movable and usable st and the bridge was initially balan with removable concrete blocks. F tests were made April 4 and, on following day, naval vessels pa through the opened draw of a bridge—a symbol of America's d mination that the ships shall pass.

In considering this problem bridge conversion, the city's e neers, particularly G. A. Hein bridge designing engineer, had m factors to weigh. The existing cro had four separated roadways total

TABLE OF QUANTITIES AND CLEARANCES

Overall width of bridge	145 ft.
Horizontal clearance (below + 17.0 ft.) (for barges)	160 ft.
Horizontal clearance (below + 21.0 ft.) (for barges)	120 ft.
Horizontal clearance (above + 21.0 ft.) (for vessels)	105 ft.
Maximum vertical lift	28 ft.
Vertical clearance (bridge closed)	21 ft.
Vertical clearance (bridge open)	49 ft.
Quantities of Materials:	
Structural steel	1,525,000 lb.
Wire rope	4,000 lin. ft.
Forged and cast steel	110,000 lb.
Timber	140,000 b. ft.
Concrete (mainly counterweight)	430 cu. yd.

lanes for vehicular traffic, two of ich carried street car lines. Sideks on both sides brought the total dth to 145 ft., making it one of the lest bridges on record. Concrete ement and longitudinal steel stringwere carried by transverse floor ms framed into four longitudinal s of plate girders.

The fixed structure consisted essenly of two cantilever spans suspenda simple center span. Anchor arms the cantilevers spanned approxiely 62 ft. between reinforced conabutments and piers, with the tilevers extending 31½ ft. to carry 109-ft. suspended span. All parts he girders that extended 4 ft. above deck had been concrete encased.

Alternate schemes

Preliminary investigations included possibility of installing an old ed bobtail swing bridge, but this ld have provided a draw opening ess than 70 ft. and only two 18-ft. dways. Also, it would have created tortuous traffic detour, deemed hly undesirable for such an impor- traffic artery. Furthermore, the tral simple span portion of the d bridge would have required disntling because it could not be ted away.

War requirements made time a govng factor. It was desirable to id foundation and marine conction. Hence a new bridge was of question. Another important or was the adoption of a design izing as much of the fixed bridge ossible, thus requiring a minimum additional materials, and at the e time making completion possible hin a few months.

n view of these important factors lift bridge design was adopted. s involved the construction of towwith sheaves, wire ropes and counweights all supported on the overging portions of the existing canver girders. To accomplish this, it necessary that the lift bridge dead ds on the cantilever girders should appreciably exceed the original ds. By removing the heavy concrete and girder encasement on the n and replacing the deck with light inated timber joist construction, combined original live and dead stresses in the cantilevers and s were increased not more than 5 ent, despite the additional load he counterweights.

With very few alterations the simple midspan portion of the fixed bridge became the movable portion of the lift bridge by transferring its dead load reactions from the ends of the cantilever girders to the wire ropes.

Although the fixed bridge design included no provisions for such an alteration, its conversion to a lift bridge having a maximum vertical lift of 28 ft. and affording a 49-ft. vertical clearance, was completed successfully at a cost of $500,000, leaving available all ten traffic lanes and both sidewalks. Installing the stored four-lane swing bridge and construction of necessary approaches would have cost over $300,000; a ten-lane bascule, $3,000,000.

Each of the two lifting towers has eight steel columns supported in pairs on the four cantilever girders and rising to a height of 72 ft. above the girders or 102 ft. above city datum. Columns are joined by bracing members and girders over all roadways, forming structures 32 ft. wide by 125 ft. long with a skew of 12¼ deg. in conformity with that of the bridge. Upper parts of the towers are enclosed and roofed to protect the machinery.

Each tower carries four 10½-ft. dia. all-welded structural steel sheaves; three carry eight 1¾-in. wire ropes each and one carries six 1¾-in. wire ropes. Ropes are 6x19 modified Seale construction, with independent wire rope center. Two counterweights hang from these ropes within each tower.

Each of the four movable span girders is suspended by a structural steel hanger at each end which transfers the movable-span dead load to two

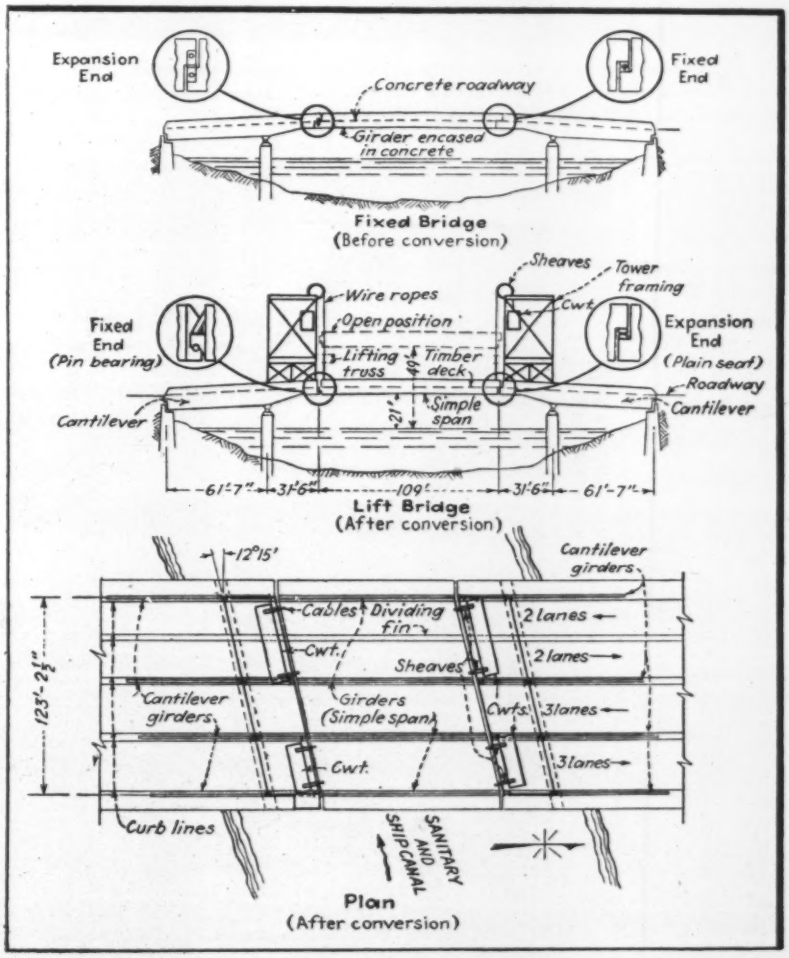


Fig. 2. Although originally designed for the central simple span to be supported by the cantilever girders, the remodeled structure permits its being raised to 49 ft. above the canal.

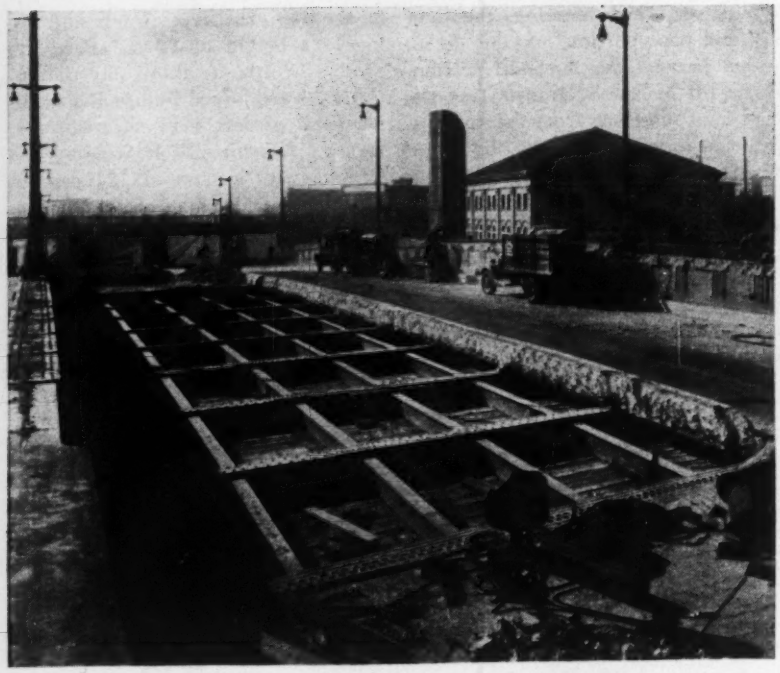


Fig. 3. Removal of the old concrete encasing the longitudinal steel girders and substituting timber joist construction for the old concrete deck prevented an increase in original design stresses.

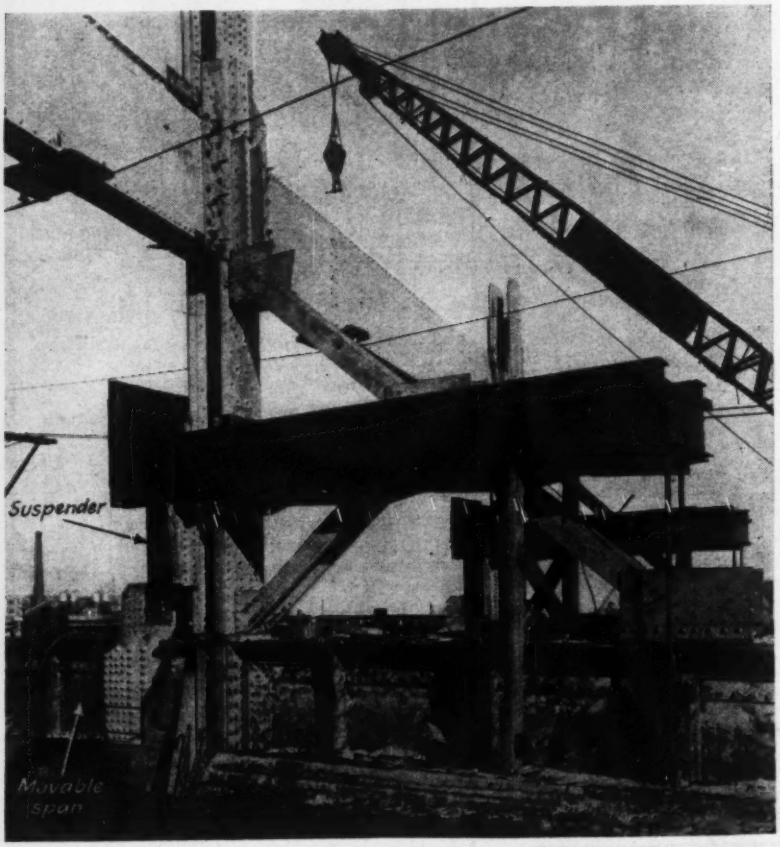


Fig. 4. Steel "suspender" plates rigidly connected to a double I-beam girder mounted on the cantilever girders, and pinned to the movable span, supported it during remodeling.

continuous lifting trusses 11 ft. deep, extending over and across the movable-span roadways, and located adjacent and parallel to the front of each tower. Lifting trusses are attached to the wire ropes 6.6 ft. from the centerline of the girder and hanger in each case, the centerlines of the sheaves and ropes being at right angles with the skew of the span.

Lifting trusses minimize distortion

In an attempt to eliminate the necessity for lifting trusses, consideration was given to the use of two sheaves for each set of ropes, hanging the counterweights on the backs of the towers instead of within. In that case all sheaves could have been located on the centerlines of the main girders, permitting the ropes to connect directly to the hangers. However, because of the great width of the bridge and the lack of transverse rigidity originally incorporated in the central span of the fixed structure, it was felt that the use of deep lifting trusses would minimize the dangers of roadway distortion during lifts.

Although this double-sheave arrangement would have had the advantage of reducing the load on the cantilevers by transferring the counterweight loads directly through the rear columns to the piers, it would have necessitated the use of a cable operating drive, doubled the number of sheaves and increased other critical materials. The sheave drive design was adopted for its simplicity and economy, and it turned out to be a fortunate selection from another most important angle; that of time for completion. Obtaining the heavy plates for the welded sheaves, together with their fabrication and machining, determined the date of completion. Consequently an increase in the number of sheaves would have added weeks to the time necessary for completion.

Operating power for the lift span is supplied by two 50-hp., 440-v., a.c. motors atop each tower, one motor on each tower being the operating motor, the other the tie motor which is "synchro-tied" across the canal through cables suspended between the tower tops. Power is transmitted from the motor through speed reducer and shaft to racks on the rims of the sheaves, raising or lowering the span through the friction of the ropes on the sheaves. All machinery, motors and other equipment in both towers

s well as the roadway gates and signals on the south approach, are remote-controlled from the operator's house located above one of the sidewalks. Gates and signals on the north approach are operated from a nearby control box.

Lifting tower supports unique

Aside from the great width of this lift bridge, perhaps unparalleled in movable bridges, the cantilever supports for the main towers are unique in design. The rear columns of the towers are over masonry piers, while the front columns, carrying about 90 percent of the movable span and counterweight loads, are supported on the overhanging ends of cantilevers about 30 ft. streamward from the centerlines of the piers. This arrangement does not overstress the silicon steel cantilever girders because of the great reduction of the span weight previously mentioned. The original weight of the central span was 3,940,000 lb. while the present weight is 1,840,000 lb. The present total load of the lift bridge, including dead loads, live loads (based on heaviest live loading assumed in fixed bridge design) and impact, on all that portion of the bridge between river piers that is carried by the cantilever girders, exceeds the former total by only 5 percent.

Although it was realized that the location of the towers on the cantilevers made difficult the problem of adequately protecting the structure against vessel collision, the urgent necessity for a speedy conversion and strict economy in the use of critical materials left no alternative. To protect the bridge during the passage of large hulls, barges are berthed under the cantilevers along the offshore piers. Studies are being made for a more permanent type of protection which would obviate the use of the barges.

Fig. 5. Hook-like projections on the movable span girders bear on steel pins of the cantilever girders to take live load reactions when the span is closed.

Novel scheme saves three weeks

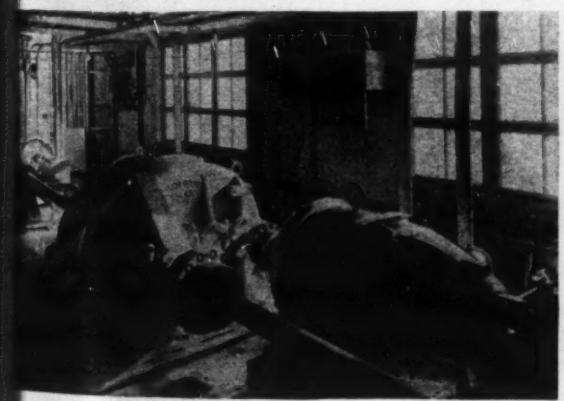
Considerable field work was necessary to alter the ends of the cantilever and suspended span girders to provide seats for the movable span, and to alter the roadway and street car rail joints at the south end of the lift span. This work could not be done until the lift span load was removed from the original hangers or links on the ends of the cantilever girders. In order to save possibly three weeks construction time, which would have been required if this work had not been done until after the counterweights were in place and the span suspended on the permanent cables, a novel scheme was used of temporarily carrying the south end of the lift span on "suspenders" to permit the required alterations to be made concurrently with erection and before the towers were completed.

Four construction suspenders were provided, one for each of the four girders. Each suspender was essentially a multiple-plate hanger bolted to the central span girder webs and suspended from an overhead double I-beam cantilever that was supported on the fixed part steel above and in line with the cantilever girders. The lower sections of the four front tower columns along this end of the central span, together with their overhead connecting portal girders, were erected in advance to permit utilization of the column sections for supporting the I-beam cantilevers. The portals afforded adequate lateral stability for the columns and suspender assemblies. Two bolts, anchored to the main fixed girders resisted the uplift of each suspender cantilever.

Movable span supports

As a part of the fixed bridge, the north ends of the central span girders were fixed, and were carried on offset seats. The south expansion ends however, were carried by suspension links and pins, the upper pins being held by projections of the upper portion of the cantilever girder webs, the lower pins by projections of the lower portion of the span girder webs.

To obtain satisfactory girder support details for the movable span, it



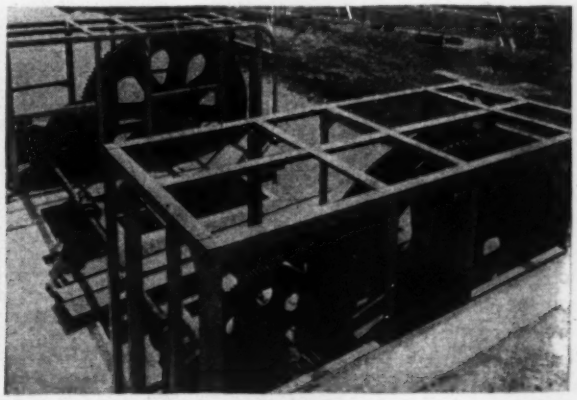


Fig. 6. Two 50-hp. electric motors (left) with proper speed reducers and automatic brakes operate the 10½-ft. dia. all-welded sheaves shown at the right, which are equipped with wire rope for lifting the movable span.

Fig. 7. Although lacking in architectural beauty, the remodeled bridge provides 49-ft. clearance over the canal, permitting the passage of large war craft.

was necessary to provide for expansion at the north end, which was done with slight modifications of the existing offset seats. At the south ends, however, more extensive alterations were made while this end of the span was carried on the construction suspenders. The pins and links were removed; the upper projections of the cantilever girders which would have interferred with the free vertical movement of the span, were cut off entirely and replaced by wing plates bored to receive the lower pin; the bottoms of the lower projections of the span girders were cut along a horizontal line passing through the center of the pin hole so that the web ends of the span girders formed a hook-like bearing. When the span is lowered these hook-bearings come down between the fixed-part wing plates and bear on the upper half of the wing plate pins. All movable span end bearings are designed to carry live load only, the dead load being taken through the hangers and ropes to the counterweights.

Construction difficulties

Most of the field work proceeded under extremely severe winter conditions. Work continued during as many hours each day as safety considerations permitted. Under the specifications, field work essential to the movable-and-usable stage, was required to be carried on throughout 24 hours per day, seven days per week, including holidays. The contract included a time charge arrangement, under which the contractor's compensation was increased by vigorous prosecution of the work or reduced by procratination.

Due to the heavy manpower demands of other projects in the Chicago area at the time, some difficulties were experienced in securing an adequate force of ironworkers and other skilled help. To insure completion of the bridge on the required date, and upon requests from the contractor and the Navy representative, several riveting gangs and other skilled workers of the city's construction division were loaned to the contractor and the cost thereof deducted from his contract payments.

Various other difficulties, less serious, had to be overcome as the work progressed. Regardless of all this, street car traffic was maintained throughout the alteration. Vehicular traffic was closed on some lanes at times but at no time during the erection was the bridge completely closed to such traffic.

Provides route to sea

The bridge was made operable on April 4. Thereafter, additional time was taken for final completion of various minor features and for replacement of temporary installations made to permit early operation. However, the essential purpose, removal of the navigation barriers and the opening of the Lakes-to-Gulf route to the sea as an outlet for Great Lakes shipyards, had been accomplished.

This South Western Ave., bridge was one of nineteen bridges over the Sanitary and Ship Canal which were made operable under Navy contracts by rehabilitation, alteration or installation of operating equipment and controls. The project herein described was the largest of these and involved the only fixed bridge required to be

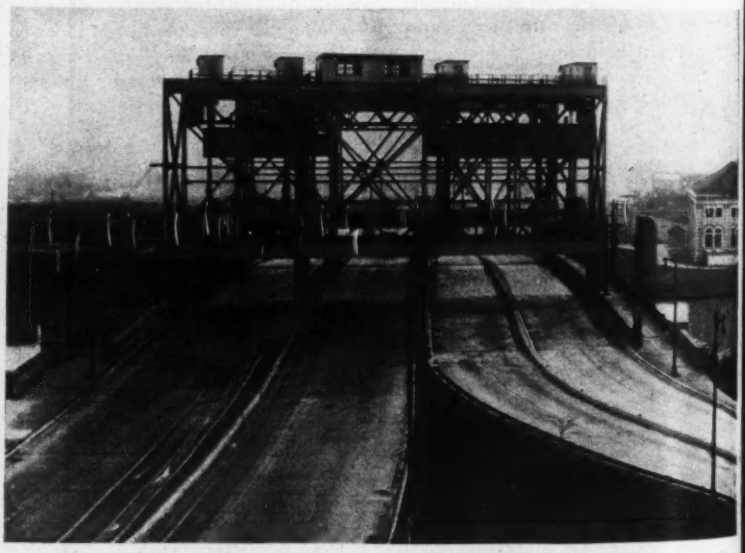


Fig. 8. Traffic on the ten lanes provided by the 145-ft. deck of the crossing, including two street car tracks, plus two sidewalks, was not seriously interrupted during remodeling.

movable. In addition, the city, its own forces, under supervision W. Hansen, engineer of bridge tenance, made operable one and four bascule bridges at a of $200,000, by rehabilitating the hinery, and installing electric rs and control equipment.

Contracts and personnel

he contract for the structural al- tions, towers and machinery was by Wm. J. Howard, Inc., of Chicago. The American Bridge Co., fabricated the steel. All electrical work was done under contract by Divane Brothers of Chicago.

The U. S. Navy, Bureau of Yards and Docks, under Rear Admiral Ben Moreell, chief of the bureau, financed the project. It was represented by Comdr. Howard L. Mathews, C.E.C., U.S.N.R., as officer-in-charge-of-construction.

The Department of Public Works effected the conversion under the terms of a contract with the Navy. Much time and personal attention was devoted to the direction, supervision and expediting of this project by O. E. Hewitt, commissioner of public works, W. W. DeBerard, city engineer, and the author, on whose staff were the following: D. N. Becker, engineer of bridge design; W. E. Lofgren, assistant engineer of bridge design, who functioned as special consultant; and C. O. Johnson, resident engineer, in charge of construction.

einforced Concrete Best Substitute for Manhole Covers

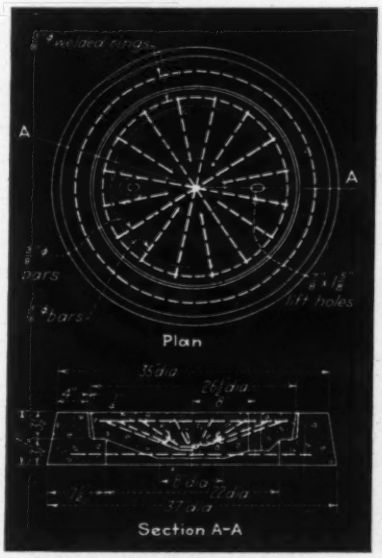
ubstitute materials to be used in of cast iron manhole covers in streets, were thoroughly investi- in Los Angeles when it was real- that substitutes would have to sed for new construction and re- ements until the war is over. After g eight different types and mak- studies extending over several ths, it was concluded that each titute was lacking in some par- ars and hence less satisfactory cast iron for permanent specifi- ons. In short, Los Angeles devel- no satisfactory substitute, and n they are again available cast covers will be used. Meantime, most satisfactory substitute for under heavy traffic was found to reinforced concrete cover of the shown in the accompanying wing. The city engineers' report he tests is summarized in the fol- ng.

ncluded in the substitute materials manhole covers that were investi- were (1) Douglas fir timber ed and glued together, (2) three- Douglas fir and maple glued with rproof glue under recommended sures and treated with synthetic preservatives, (3) four-ply lwood glued with waterproof glue fastened together with wooden els, (4) built-up Celotex layers egnated with synthetic plastic ma- l, (5) asbestos cement concrete, reinforced concrete, (7) natural e and (8) rails and concrete.

he plywood assemblies, fabricated cold-setting waterproof glue, n subjected to alternate wetting drying tests, disintegrated rapidly were reported as unsatisfactory. covers made of Douglas fir timbers glued and bolted together warped badly after a short time in use and the glued joints failed to hold.

Those made of built-up Celotex layers impregnated with synthetic resin were ruled out when found to be too soft to stand the battering of traffic. Asbestos cement concrete and also natural stone were too brittle. The covers fabricated of used steel rail and concrete were unsatisfactory "because of the brittle quality of the rails and the difficulty of maintaining the shape of the assembled steel members after they had been cut by the gas torch."

Although concrete covers are difficult to handle, the seating is unsatisfactory and the durability is uncertain, the most nearly satisfactory of all the substitutes tried was the reinforced concrete cover design using about 10 lb. of bar steel, shown in the accompanying drawing. This was developed by the American Concrete Institute. Note that reinforcing steel is nowhere less than 1 in. from the outer surface of the concrete. The frames weigh 325 lb., ready for installation, and the covers themselves 202 lb. The concrete mix used is made up in the following proportions: 175 lb. pea gravel, 280 lb. sand, 1¼ sack cement mixed and not more than 3½ gal. of water per sack of cement.



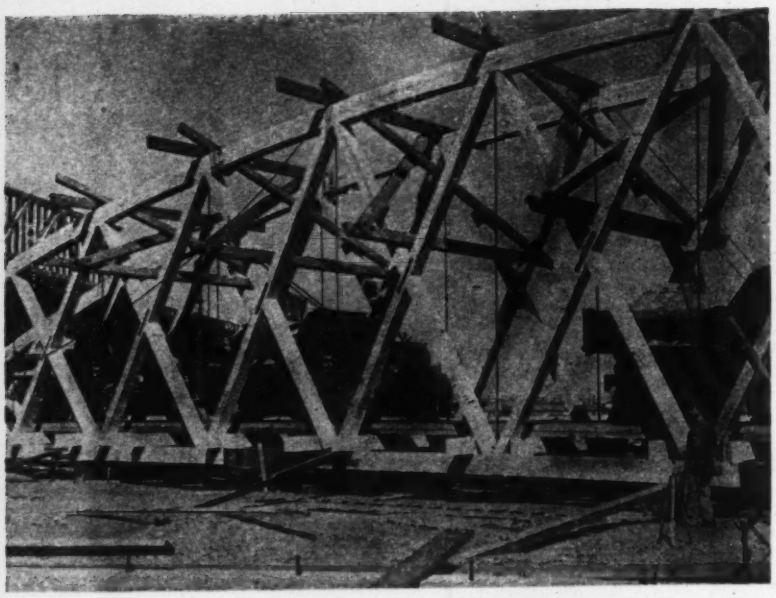
Concrete covers of this type were the most satisfactory under test of those made of substitute materials.

For protection of concrete surfaces to be exposed to sewer gases two coats of coal tar bituminous water-and-acid-resisting paints are applied. The first coat is a priming solution put on at a spreading rate of not more than 200 sq.ft. per gal. After it has dried a second or surface finishing paint is applied at a rate of about 100 sq.ft. per gal. Application by spraying is permitted.

Specifications for testing the concrete manhole covers require that from each lot of 50 covers, one be selected for test under a load applied to the cover while resting in its frame on a sand bed. The load is applied through an iron plate 9 in. in diameter, in the center of the cover. The rate of loading is 10,000 lb. per min. until 27,000 lb. has been applied.

A reinforced concrete cover of the design shown in the accompanying drawing and extensively used by Los Angeles is manufactured for the city by the Art Concrete Works of Pasadena. Lloyd Aldrich is city engineer of Los Angeles.

Prefabricat



TIMBER BOWSTRING TRUSSES of 20[illegible] span, used in an addition to the R[illegible] Aeronautical Co.'s plant at San Di[illegible] were selected as most economical [illegible] requiring a minimum of critical ma[illegible] rials. In this plant a governing re[illegible] was for wide floor spaces unobstruc[illegible] by columns. The bowstring type [illegible] truss not only offered economy of m[illegible] terial in the truss itself, but resulted [illegible] lower height of side walls, less leve[illegible] age for horizontal forces and adva[illegible] tages in camouflage treatment. T[illegible] building is 200x570 ft. in plan and h[illegible] a clear height of 35 ft. under the lo[illegible]

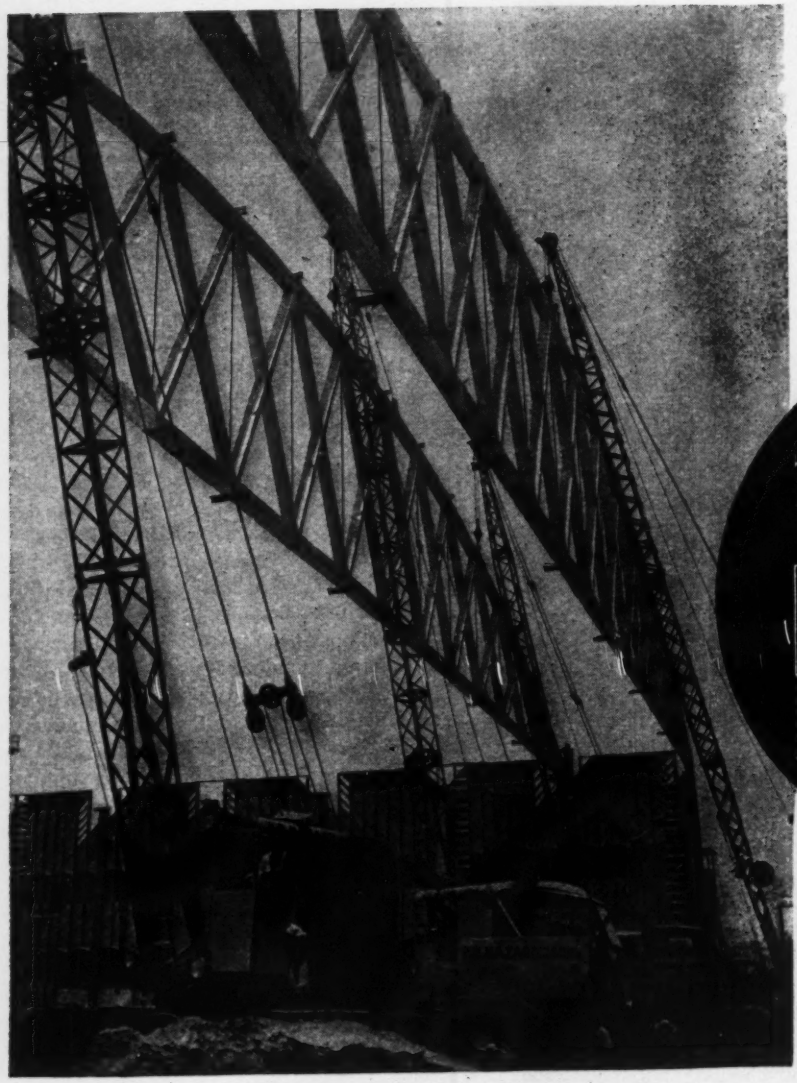


Fig. 1. In order to determine the ma[illegible] mum deflection of these green timb[illegible] trusses, they were first set up on t[illegible] ground and loaded with trucks (a[illegible] shown at top left) to simulate desig[illegible] load conditions.

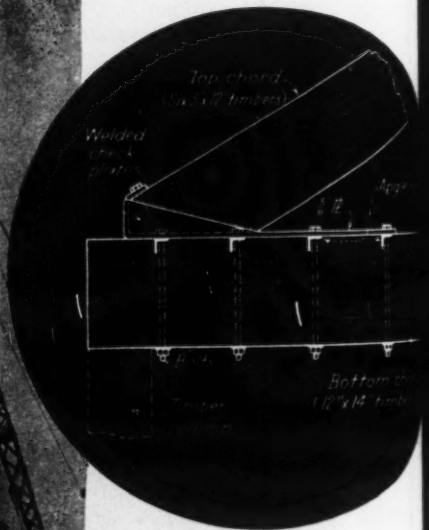


Fig. 2. Detail of the heel joint at e[illegible] of the 200-ft. truss span is shown above. Three crawler cranes (at left) are lifting a 200-ft., 20-ton truss into place, while a fourth crane is employed to hold the first truss erected in the upright position.

nber Bowstring Trusses 200 Ft. Long

chord of the roof trusses. The ses are 25 ft. high (one-eighth the n) and are spaced 19 ft. apart. Government directives under which design was developed made it man- ory to use utmost economy and to re stresses at the maximum per- ssible for the materials used. The er chords of the trusses are lami- ed, consisting of six 3x12-in. tim- s. This design permitted the use of aller sizes of timber and simplified mation of the curve. The lower rds are solid 12x14-in. timbers ned with steel splice plates. Com- nent parts of the trusses were made at the mill to fit a template and se parts were shipped for assembly the job.

recautions used to insure rigidity

To minimize shrinkage, checking distortion, all lumber was treated hot solution of wood preservative. rticular care was used in making daps for the diagonal joints, and re steel keys were employed at heel nts and in lower chord splices, ce was left in the daps for pouring melted lead. This work is reported have resulted in good fits and an al distribution of stresses among keys. The resulting stiffness and formity of deflection are said to be satisfactory.

Design provision was made on the er chords for a moving monorail of 5 tons. All vertical members in tension and are therefore steel , being of 1⅛-in. dia. All diagonals figured in compression, and are 2-in. timbers. Stresses in these gonals reverse under influence of monorail load, making one set of diagonals inoperative while the er is working.

Trusses tested at maximum loading

The trusses were assembled when only available timber was green wet and, hence, lower in struc- al value than when seasoned and . Therefore, as safety factors were uced to a minimum by the direc- s requiring maximum permissible ding, it was decided to make a scale load test. For this test two trusses were set up on the ground, and loaded with a string of trucks, to simulate full design load conditions. Under this test a maximum deflection of 4¾ in. was observed at the middle of the span. As a result of this loading made on green timber, minor, additional reinforcement was considered advisable in the heel joint. Details of the heel shoe are shown in Fig. 2.

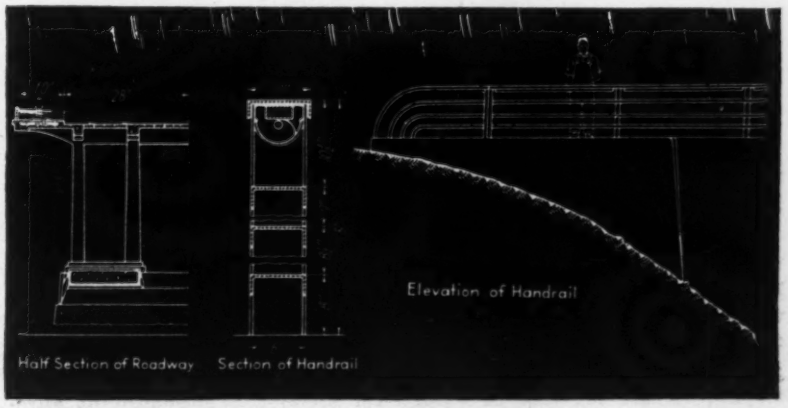
The problem of lifting these 20-ton trusses into place on walls 35 ft. high was involved less with the actual weight than with avoidance of excessive distortion or overloading of individual members. Reversal of stresses incidental to hoisting into place had been provided for in the design. Four crawler cranes were employed until a few trusses were in place and tied together by the horizontal and vertical bracing systems to laterally support those following. After passing this construction stage three cranes sufficed; one at the center and one at each quarter point. The closest coordination between the crane operators was necessary to maintain equal distribution of loads while maneuvering the trusses into position.

The component parts of the trusses were manufactured by the Arch Rib Truss Co. for the Ryan Aeronautical Co. The design of the structure was developed by Stanley Burne, consulting engineer, San Diego.

Lighting Standards Eliminated In Novel Bridge Lighting Design

Experiments are being carried on by the bridge department, California Division of Highways, with a novel scheme for lighting the sidewalks and roadway of bridges. The new method, as indicated in the accompanying sketches, has the advantage of entirely doing away with lighting standards such as ordinarily are built for bridge deck illumination and are usually extensions of the handrail posts. With the new location for lights, rays are not directed into the eyes of motor vehicle drivers. It puts maximum illumination on the sidewalks and at the edges of the roadway.

Although the method is as yet in the "try-out" stage, the expectation is that the most economical source of light will be luminous tubes mounted horizontally in a position of maximum security and protection beneath the handrail.



Bridge handrail carries reflector for concealed source of light, eliminating standards.

Fig. 1. Surveyors and soldiers constitute this field party mapping one of Brazil's unexplored rivers.

Mapping Brazil's Jungle Boundaries

Louiz de Souza Martins
Assistant to the Chief of Operations—Div. I
Brazilian Commission for Frontier Demarcation
Belem, Para, Brazil

***Editor's Note**—One would little suspect, on entering the cloistered, library-like offices of the Frontier Commission on a quiet street in Belem, that this is the nerve center of an organization whose activity constitutes one of the most adventuresome to be found in the world. From here go forth surveying expeditions to explore and map the vast and unknown territory of northern Brazil. An inspection of the commission's archives reveals the wealth of vital information that has been collected. But it is in the "museum" room that one gains a vivid impression of what the field parties face in procuring these data; here are assembled some mementoes—stone knives, blowguns, arrows with poisoned tips and bows of huge size—that explain why soldiers must always accompany the surveyors. However, this aspect of the job is of no novelty to Dr. Martins, author of the following article, who describes some of the technical accomplishments of the commission.*

FRONTIER DEMARCATION invariably follows immediately in the wake of diplomatic action. Thus the treaties with Argentina, Colombia, Bolivia, the French Colonial Empire and the vast British Colonial Empire that established the exact layout of the great polygon of which Brazil is formed, created the task of fixing boundaries between Brazil and her South American neighbors.

Work of this kind, first undertaken in the colonial period, is carried on by the Commission for Frontier Demarcation. Its activities involve the exploration and mapping of areas, some of which are almost entirely uninhabited, and it is particularly concerned with topographical surveys, establishment of astronomical positions, and the collection of data on geology and climate.

The following is an account of the work of that section of the Commission assigned to the demarcation of boundaries in northern Brazil. It was prepared at the request of a member of the staff of *Engineering News-Record* who visited our work in September, 1943, and we take great pleasure in having this opportunity to acquaint North American engineers with our efforts.

In contemplating the geographic expanse which Brazil possesses today, limited on the south by parallel 33 deg. 45 min. S. and on the north by parallel 5 deg. 16 min. N., we must render homage to the valiant Portuguese explorers who penetrated the dense forest, with its many unknown factors and pitfalls, and created this great patrimony which is a cause of pride for a people and a stimulus for its spirit of enterprise.

The story of these remarkable pioneer migrations, which has come down to us from early colonial times, is full of dramatic highlights and of almost superhuman sacrifice. Many

who took part in those bold ventures paid for their temerity with their lives, victims of diseases or of treacherous attacks by savages and wild animals, "and remained to sleep their eternal slumber in those immense wastes." But the record of these amazing exploits is for us a heritage, and a concrete and graphic proof of the great heights of which human courage is capable.

Features of the border area

The northern frontier of Brazil, largest country in South America, marks at the same time the southern borders of five countries: the French, Dutch and British Guianas, the republics of Venezuela and Colombia. It has a length of about 3,445 miles. To obtain an idea of the work carried out every year and of the difficulties encountered, it is necessary to sketch for the reader the physical characteristics of these lands still incompletely known and studied. The huge stretch of territory north of the gigantic Amazon is the area in which the work of the Commission for Frontier Demarcation—First Division, is centered. This organization has been headed since 1929, by Captain Braz Dias de Aguiar.

Fig. 2. Concrete monument marking border of Brazil, Dutch and British Guianas

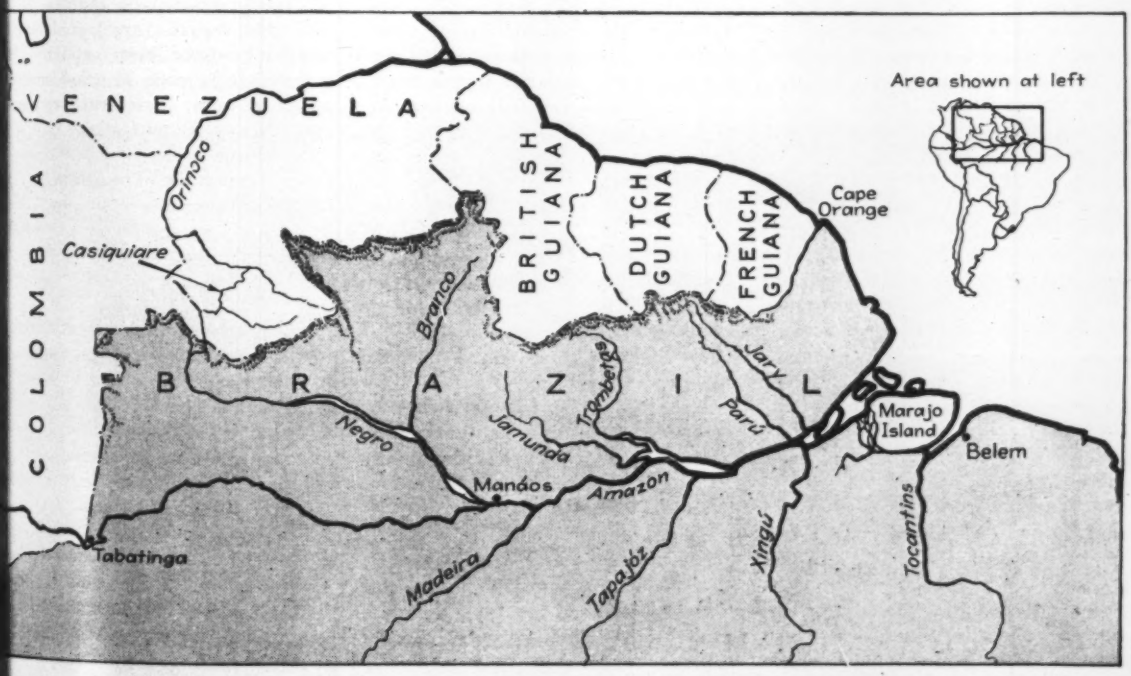
Almost all of the immense territory to the north of the Amazon River, designated by geologists as "the Guiana bulwark" is, of Archaean formation (the oldest period of geological history). It embraces part of the basin of the Rio Negro, the largest left-bank tributary of the Amazon, and part of the basin of the Rio Branco.

From a physiographic standpoint, the huge expanse constituting the Amazonian plateau presents three interesting features: Solid ground, entirely out of reach of the floods; lowland, periodically flooded; and swampland, constantly under water.

Our attention centers on the vast portion of tropical America which Humboldt called *Hyléa* (equatorial rain forest), because of the innumerable watercourses which make this region the most highly irrigated part of the globe and give rise to the greatest variety of flora.

This vast expanse, bounded on the north by the Pacaraima and Parima, the Acari and Tumuc-Humac mountain systems, and on the south by the left bank of the Amazon, is distinguished because of its horizontal orientation. It is worth mentioning that the locality named Tabatinga, situated on the Brazilian-Colombian border, at a distance of 1,925 mi. from the Amazon mouth, is at an altitude of only 197 ft. above sea level.

Six large rivers empty into the gigantic Amazon artery on its northern shore. From east to west they are the Jari, the Eastern Paru, the Trombetas, the Jamunda, and the Negro. The first two stem from the southern slopes of the great Tumuc-Humac range, and the third and



3. Area in which the Brazilian Commission for Frontier Demarcation is working. The northern frontier of Brazil borders on five countries: French, Dutch and British Guianas as well as Venezuela and Colombia. The border has a length of about 3,445 miles, some of it in the mountainous ridges of the Pacaraima, Acari and Tumuc-Humac systems.

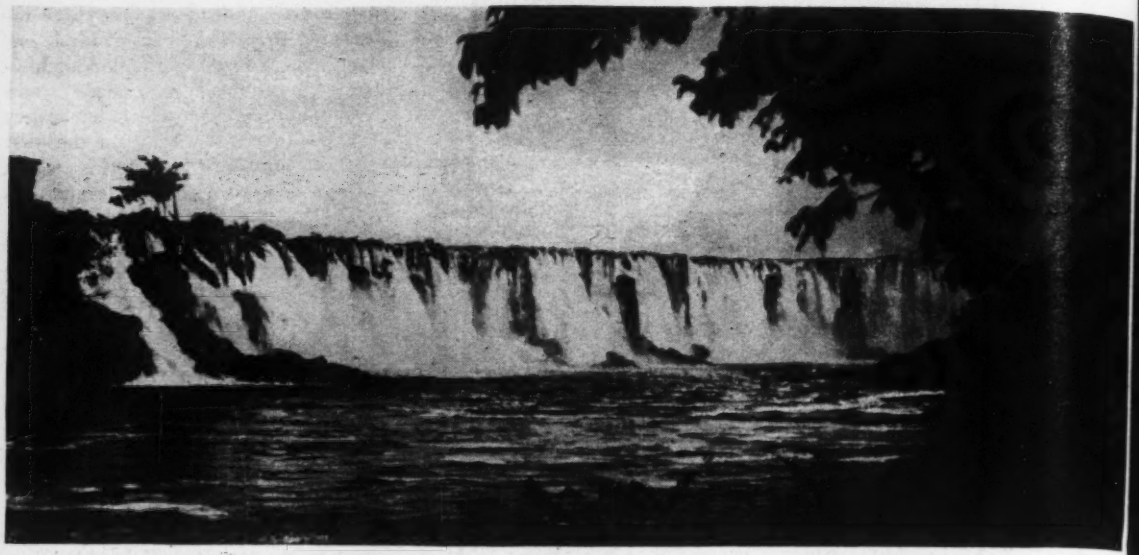


Fig. 4. Santo Antonio Falls, one of the most impressive sights on the Rio Jari, completely bars navigation at this point. This river, one of the biggest tributaries on the lower Amazon, has been explored by the Frontier Commission.

fourth from those of the Acari mountains.

The Rio Negro, which has its source in a spur of the Columbian plateau, at a point not yet precisely determined, is the largest river of this group, with a drainage area of 276,000 mi.

This river is distinguished by the dark color of its waters, a phenomenon which has greatly intrigued the curiosity of investigators. Discovered in 1542 by the navigator Orellana, it has always been a point of attraction for the world's most imminent naturalists and geographers.

The geographic and political importance of the Rio Negro is incalculable since, besides traversing territories of three great nations (Brazil, Colombia and Venezuela), it connects with the great Orinoco by means of the natural canal known as the Cassiquiare, 227 mi. in length, discovered in 1744 by the Jesuit priest Manoel Roman.

In the opinion of the Brazilian geologist Glycon de Paiva, this canal, whose difference in level between its upper and lower entrances is 79 ft., was originally a tributary of the Rio Negro. It has a well-defined hydrographic basin and is fed by numerous tributaries, including the Siapa. Its bed has slight decline, is free of physical obstacles, and the amount of water drained from the Orinoco represents scarcely 10 or 20 percent of its total flow.

The Rio Negro represents the classic type of rivers of low alluvial content which have established their profile. It is the antithesis of almost all the watercourses of the Amazon plain which carry large loads of eroded material and are generally prone to shift their beds.

River exploration procedure

Besides the demarcation of boundaries, the Commission performs geographic work of large scope, represented by extensive explorations carried out on the north slope of the Pacaraima and Parima ranges, and by the determination of a considerable number of astronomical positions in order to correct and adjust topographical surveys.

Exploration work generally begins at the mouth of the rivers, many of which are known only for a short distance in their lower course and are roughly mapped.

Expeditions carried on steam or gasoline-driven boats of varying size (100 to 1,000 tons) up to these river mouths must here be transferred to craft of shallower draft, driven by outboard motors of 2½ to 8 hp. These scows, whose draft does not exceed 2 ft., proceed as far as the middle sections of the rivers, or more exactly up to the lower edge of their rapids.

With the exception of the Rio Jari, which has an impressive waterfall completely barring navigation at one point on its lower course (Santo Antonio Falls), the big differences in level in the other tributaries of the north shore of the Amazon River occur in the upper portions, i.e., in the section where the flows are compressed between the broken cliffs of their mountain sources.

On meeting obstacles which bar further navigation on the scows, the crew and supplies are transferred to smaller boats of lesser capacity (660 to 2,200 lb.), made of wood and propelled by oars; these craft frequently reach the upper part of the rivers.

Reaching the navigable river terminus in canoes, the expeditions proceed to the river sources on foot, over lengthy and narrow trails blazed along the river banks.

Many hardships faced

The hardships imposed on explorers in these upper reaches of the rivers, both by canoe and foot travel, are innumerable. There is also no end to the number of times that canoes and baggage must be carried entirely on the backs of the crew members for relatively long distances. On other occasions it is necessary to dig a sufficient channel in the river bottom to clear the canoes. The tasks of removing obstacles from the river bed are also very frequent when fallen tree trunks resulting from bank erosion block the way.

In the upper reaches where the distance between banks decreases rapidly

d constantly, the branches of the es on either side interlock, forming unnel of living green.

All the rivers are topographically rveyed by telemeter and compass the sections permitting extended ws. In the upper streams, where rves follow in rapid succession, se operations are done on land and measurement of distances between successive points is made by stadia metric steel tape.

The high points that rise along the nks are established by means of muth intersections. Along the river rses, the astronomically determined itions are generally spaced at dis- ces varying from 31 to 62 mi. ac- ding to the lesser or greater num- of sightings.

Watershed determinations

On reaching the headwaters of any the rivers which descend from the iana massive, the party is con- nted with a special problem: De- mination of the watershed line be- en the Amazon and the basins posite, by means of a detailed and ensive exploration of the streams the opposite slope.

This operation requires skill and e, since the streams originating in se highlands are many, and their ntless curves and meanderings ily confuse the explorer. These ill- ined "threads of water" that crop on the mountainside, cascading ween blocks of granite, often have hidden courses and can be detected only by the rhythmic beat of their waters flowing underground.

From a clearing opened by machete in the forest that covers these mountain tops, with sufficient width to permit sighting a star at an angle of 10 deg., numerous exploration trails lead to the sources of the fickle brooks and accompany their courses for scores of miles, or until their general direction becomes perfectly well defined.

These tortuous paths are surveyed and leveled and the general network making up the numerous streams is sketched on a large scale on the field map. Consultation and study of this map provide a sure basis for the definition of the watershed.

Together with surveying operations astronomical observations are made to determine the geographical position of the border point where a concrete post will later be erected. Latitude and longitude are obtained by the classic methods (Sterneck, Talcott, Gauss, Stechert, Zinger, Delambre or circum-meridian techniques) during several nights of observation.

Precision of longitudinal calculation depends especially on the excellent series of time signals transmitted by various North American radio stations. The crews of the Commission always carry an excellent portable radio transmitter and receiver, of 2 watts power and a working radius of at least 600 miles, operated by dry batteries.

Observations to determine magnetic declination are made in all astronomical stations. The engineers in the bordering country make the same operations. The results obtained by the two commissions are compared and reconciled, and their average is adopted as the final result.

Altitudes above sea level are computed from a long series of hypsometric (boiling point) and barometric observations. Both the thermometers and the aneroid barometers are carefully checked for calibration before the start of the expedition.

Aero-photogrametric surveys

Besides exploring the rivers along a wide stretch of the border shed and of the streams of the opposite slope, the Commission builds on the ground, the aero-photogrametric signs that serve as reference points for the aerial survey of our borders with the Republic of Venezuela.

These signs or markers have three elements, that is to say, they consist of one principal element of identification and two auxiliary ones of lesser size, orientated in the direction of the magnetic meridian and generally equidistant from the center of the first.

The maximum distance between the central marker and each of the auxiliary ones, as adopted in the work being carried out on the frontiers, is 8,200 ft. in a straight line.

As may readily be supposed, these markers play a fundamental part in

5. Rivers are the only means of access to many areas, but they also involve transportation difficulties. Navigating Rio Demeni, the surveying party had to contend with conditions as pictured above.

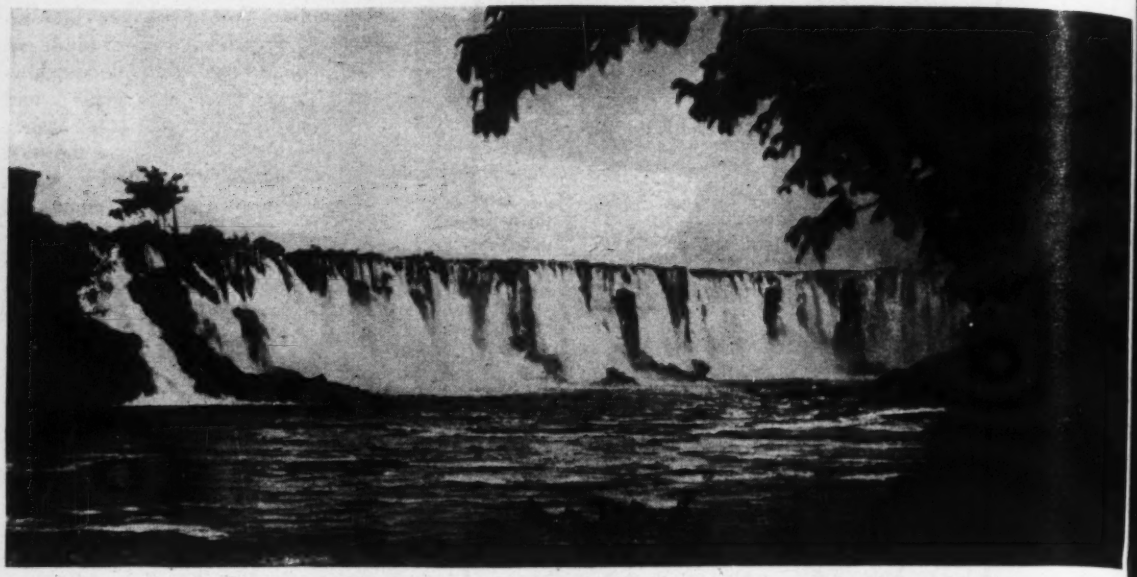


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Fig. 6. Malaria is the greatest disease hazard with which the field parties must cope. Pictured here is the expedition's doctor examining a blood smear.

the layout of the map and the determination of its scale. The geographical position and the altitude of the center of the principal sign are computed as a factor in a long series of astronomical and barometric observations. Thus the altitude of the auxiliary markers, as well as their distance from the center of the principal marker, are determined with the greatest degree of precision.

The above mentioned reference points are made to fall near the borderline or upon it. In the first case they are connected by a careful survey to a concrete signpost erected on the watershed. In the second case, that is to say when the surface of the crest of the dividing range permits the construction of the principal marker, the center of the latter consists of the post itself.

Value of air surveys

Application of the aero-photogrametric method to map making gave new meaning to geographic explorations, both as regards the large radius of action in which such operations may be conducted in minimum time, and as regards the degree of perfection characterizing them. This perfection is intimately related with the greater or lesser number of reference points found on the terrain, as well as with the physical characteristics of the latter and the climatic conditions of the region under study.

In other words, densely populated zones are admirably suited to aerial survey and give excellent results, since they offer numerous checking points, with precisely measured bases and carefully determined altitude points. When this group of favorable circumstances is present, the results will be excellent and are reflected in the precise orientation of the map, in the exact determination of its scale, in the representation of numerous details and in the accuracy of the reproduction of topographical relief.

Although the condition of the northern border strip, as regards the number of bases and points of reference, does not correspond precisely to what might be demanded of a high-precision aero-photogrametric job, adequate accuracy has been reached throughout, thanks to the painstaking astronomical and topographical operations upon which are based the study and construction of the control points.

A high degree of precision may be attained when the aero-photogrametric work is based on geodetic triangulation. In addition, such precision requires other favorable factors, such as the possibility of low-altitude flights to permit identification of details and the organization of large-scale maps, the number of views in inverse proportion to the square of the altitude of the flight, and the utilization of a large number of fixed points.

But operations of this type demand great expense and considerable outlay of time, and are warranted only in a region whose economic value is such as to compensate the capital outlay that must be invested in the making of the map.

As a closing comment in these brief remarks on the aerial survey of our Venezuela boundary, we wish to stress, and we do so with extreme satisfaction, that the yield of the work undertaken has fully met the expectations of the frontier demarcation authorities. A large section of the boundary, extending from Mount Roraima to the neighborhood of the sources of the Uraricoera, western component of the Rio Branco, has already been photographed.

The volume of work carried out by the Brazilian Commission for Frontier Demarcation—First Division, during the period of 1930 to 1943, may be appreciated from the following figures:

Surveys Made	Miles
Rio Negro basin	2,960
Rio Trombetas basin	282
Rio Jari basin	356
Brazil-Venezuela frontier	144
Brazil-Brit. Guiana frontier	1,000
Brazil-Dutch Guiana frontier	368
Total	5,110

Astronomical Points Determined	
Brazil-British Guiana frontier	169
Brazil-Venezuela frontier	81
Brazil-Dutch Guiana frontier	62
Total	312

Field party sanitation

The most widespread disease in the regions in which the Commission carries out its work is malaria, and it maintains a health service perfectly equipped to combat this malady. Preventive prophylaxis against malaria consists of the use, in suitable doses, of "atebrine" and "plasmoquine" during the entire period of the expeditions' stay in swamp regions. This

ylaxis, in conjunction with
n protection from the transmit-
insect, minimizes the possibility
fection and assures the creditable
t always obtained in our ardu-
ork.

e exploration crews consist, as a
of 60 men, including technicians,
rs and civilian workers. The
ers must have the robust strength
red for their heavy work, and
s guaranteed by a rigorous medi-
amination to which the selected
cants are subjected. The muscu-
fort demanded of these men in
various services is considerable,
they row, pole or tow the boats
higher river stretches, or drag
over the shallowest river bot-
They march for days and days
rough and almost impassable
d or on dry river beds full of
stones and gravel, carrying, be-
their limited personal baggage,
d of provisions weighing between
d 62 lb.

ese men blaze extensive recon-
nce trails in numerous direc-
across marshy tracts or over
nd steep gorges. They also clear
areas of dense jungle, in order
e the engineers sufficient horizon
ke their astronomical observa-
and they must clear a passage
e rivers when fallen trunks bar
ay. In brief, they struggle with
ese physical obstacles under the
difficult conditions of climate,
arry the equipment and supplies
sary for the accomplishment of
reat task with which the frontier
crews are entrusted.

ery crew takes along a medical
pplied with all the essentials for
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gions hundreds of miles distant
inhabited centers. (In one in-
, an *ENR* editor was told, it
21 days for a rescue party to
a base camp when the camp
d that it was attacked by sav-
See *ENR* Dec. 23, 1943, Vol.
2.)

e kit contains a range of medi-
from the most common anal-
to serums for snake bites, hemo-
, sundry remedies and first-aid
ial. Surgical operations have
performed in the forest with per-
afety. These well organized ex-
ons also take along, as a rule,
ecessary equipment for bacterio-
l examinations, consisting of a
scope, laboratory plates and coloring matter. Before beginning the march into the forest, all members of the expedition receive an anti-typhoid innoculation, and no cases of infection of this type have occurred.

The selection of sites for base camps is made in accordance with rules developed through lengthy observation during many years' experience, and the careful vigilance maintained by the physicians who accompany the expeditions is a guarantee of their health.

Without such care and scientific protection, it would not be possible to keep a group of men, in a generally unhealthy environment, for about two-thirds of the year, in proper condition to carry out the work which requires such a high degree of physical and mental energy.

Food supply service

We have already had occasion to remark that the Commission performs its work in remote regions, uninhabited and completely without resources. It is sufficiently proved that the natural resources capable of assuring sustenance to those who propose to violate the geographical mystery of these interesting corners of the earth are positively problematical. And certainly an adequate work output could not be expected from under-nourished men. Debilitation, deficient vitamin supply, in short the failure of the whole enterprise, and death would be the fatal consequence of any such error.

Taking all these factors into due consideration, the Commission has carefully organized its supply service, establishing articulated transportation facilities through the entire length of the expeditions' routes. The provisions are inspected in the supply base set up at Belem, and are there placed in tin containers of rectangular shape (of about 5 gal. liquid capacity) and are hermetically sealed by soldering. Each of these tins contains about 28 lb. of provisions, sufficient to feed one man for 10 days. In this way the volume of provisions necessary to sustain a group of men in field service for a determined period of time may be calculated with a remarkable degree of accuracy.

Lacking population and means of communication, the extreme northern section of Brazil contains large tracts of land that still are veritable geographic vacuums. Little by little, however, these are being revealed by mapping expeditions that are carried forth at the cost of determined exploration enterprise.

Fig. 7. A base camp for one of the field parties, which includes a complement of 60 men consisting of technicians, soldiers and laborers. Completely isolated, except for radio communication, the field party will operate from such a base for several months.

Old Concrete Highway Pavements Salvage

Rex M. Whitton, Maintenance Engineer
And J. D. Chadwick, Assistant Maintenance Engineer
Missouri State Highway Department

Fig. 1. Voids below pavement are filled with a slurry of soil and cement delivered by a hose mounted on rollers to increase its life.

***Contents in Brief**—Badly cracked concrete highway pavements are salvaged by a combination of mudjacking and "decking" aimed at the elimination of pumping at all joints and cracks. After the voids beneath the slab are filled with a liquid mixture of loam topsoil and cement, the pavement is surfaced with from 1 to 2½ in. of asphaltic concrete.*

MANY FACTORS CONTRIBUTE to the failure of concrete highway pavements, but it is believed that the most critical failure today is that caused by "slab pumping," or the deflection of the pavement under a moving load. It has been proven through research and observation that three factors must be present to create a "pumping" joint. They are: heavy axle loads, "free" water under the slab, and unsuitable subgrade soil. Elimination of any one of these factors extends the life of the concrete pavement for many years.

Since a law has been passed in Missouri permitting an 18,000-lb. axle load, this factor cannot be eliminated readily. Neither is it feasible to remove and replace the undesirable subgrade soil in place under concrete pavements constructed in the days when little or no thought was given to obtaining the most satisfactory type of supporting soil. That leaves the factor of "free" water to be overcome if the useful life of much concrete pavement is to be extended until a postwar reconstruction program permits the older pavements to be replaced adapted to the needs of today and morrow. It is with this thought mind that the methods employed Missouri to overcome free water discussed.

As early as 1935, attention was rected to the erosion of the subgr under the concrete pavement on most heavily traveled routes in M souri. In 1937, one division of state highway department used a m jack to pump semi-stiff mix of and cement under the most badly d aged pavement to fill the voids cre by erosion.

The soil-cement mix was ad through one hole drilled at the in section of each transverse crack the longitudinal centerline. In l the method was extended over d sections, but the original single at each crack was supplemented two other holes, one being drille the transverse crack at the qua point of each lane of traffic. The sults with the three holes were m satisfactory than by the one- method of 1937. During the next years the sections repaired by t methods did not progress in failu rapidly as the sections not treated

Wetter mix considered better

In 1941, when pumping action noted on other heavily traveled ro where the condition had hereto been present but less intense, a spe study was made of the problem. early decision was to use a slurry of sandy loam topsoil and port cement instead of a semi-stiff mi wetter mix was expected to gi greater spread of the mixture u the pavement and to fill more of small voids and channels.

This slurry mix was obtained mixing the soil and cement, the portions being 4 bags of portland ment per cubic yard of topsoil. 50 to 55 percent of water added i pug mill of a mudjack.

servations in the field showed by the use of this slurry mix the ement would leak through to the f the pavement at cracks 20 and from the point of injection. Also, ing this mix, the pavement was t up on stools of soil and cement voids surrounding the stools, as he probable condition in previ- ears when the stiff mix was em- d. The successful method of g slurry, in detail, is as follows:

Holes drilled by one man

holes for the mudjacking are d by one man with a pneumatic ammer, using 1½ to 2½-in. bits. divisions have adopted the 1½- , since the cost per hole is less, y 7c. for a 6-in. pavement. Other tages of the 1½-in. hole are: (1) are not readily visible to the ing public, (2) when tires pass the holes they do not create a n noise, and (3) there is less g on the under side of the slab illing this size hole than with holes.

ingle workman not only drills oles, but moves the equipment as his work progresses, takes f the compressor, and shifts the ade which protects him from . He may drill as many as 318 of 1½-in. dia. per 10-hr. day, but tal varies with the condition of avement to be treated and the r of moves required per mile ement.

ing the past season one hole per transverse crack was generally used, that hole being located 10 in. from the center joint and 10 in. beyond the transverse crack or joint in the direction of travel (Fig. 3). However, believing that additional holes were required to completely fill the voids under the pavement, the department carried out experiments on two different test sections using two holes instead of one. These holes were placed in the diagonal corners. From 0.06 to 0.09 cu. yd. of additional material per crack or joint was injected under the pavement by this method.

The mudjack used is mounted on a four-wheel pneumatic tired trailer equipped with a four-cylinder gasoline motor that supplies the power to operate the pug mill and the two pistons that deliver the slurry through a 2-in. dia., 6-ply rubber hose to a steel nozzle of the type illustrated by the photograph on the previous page.

The nozzle is equipped with a 2-in. quick opening gate valve and is tapered from 1¼ to 2½-in. outside dimensions. The trailer unit is towed by a truck carrying a 500-gal. water tank and a small gas driven centrifugal water pump. The water tank is connected to the pug mill by a 1-in. hose readily disconnected when it is necessary to refill the water tank.

The mudjacking is done by an eight-man crew, consisting of a foreman, mudjack operator, nozzle operator, a workman adding material to the pug mill, a truck driver operating both trucks between the mudjack and dirt pit, a laborer who plugs the holes and cleans the surface of the pavement after jacking, a laborer at the soil pit, and a flagman. Such a crew has pumped as much as 20 cu. yd. o slurry per 10-hr. day, and averaged 16 cu. yd. per day over the 1943 season.

Free water forced from below slab

The crew pumps the slurry mixture under the pavement until the slab begins to raise. All of the free water under the pavement is forced out of the voids and drains off through the cracks and a hole dug at the edge of the pavement at the transverse crack for that purpose. This hole, which is made with a spud bar or a pick, is extended about 2 in. below the bottom of the pavement. As soon as the water has been forced out and the slurry mix appears at the shoulder, the hole is closed with tamped earth.

When the nozzle operator has added sufficient slurry at a hole he inserts a tapered wooden peg to retain all the mix under the pavement until the clean-up man can plug the hole with a thick mix of soil and cement. This latter workman, after the soil-cement plug is added, passes his shoe over the hole and obtains a slick finish that will not be destroyed by traffic. Enough moisture seeps through from below to provide dampness to make this plug set up.

Usually no attempt is made to raise the pavement from its warped position, unless a local condition is en-

Slurry is prepared by a truck-mounted pug mill moved ahead as work advances. Tank truck at left supplies the and dump truck at right the topsoil and cement.

countered where the pavement still has good riding qualities on either side of the settlement. Engineers of the Missouri department believe if they can stop the deflection of the pavement by slurry mudjacking, they can restore the riding surface with a bituminous upper deck, which will also aid in waterproofing the surface of the old pavement. This particular phase of the work will be described in detail later.

Sections pumped twice

On the sections to be decked with a bituminous mat, at least two applications of the mudjacking are necessary. After the first pumping, the slab is often disturbed by traffic before the mixture has taken its initial set, leaving voids that are not filled. Also the shrinkage of the slurry mix due to the high water content leaves some small voids. Thus, it is necessary to repump those sections before adding the mat.

The amount of slurry required varies depending on the stage of the "pumping" joints, ranging from 10 to 45 cu. yd. per mile. A 2-mile test section, where every transverse crack was treated, required 45 cu. yd. of slurry per mile for the first treatment. However, the department soon realized that it would be impossible to cover the mileage of highways requiring treatment at this rate; so the general policy of pumping only those transverse cracks that need immediate attention, as well as every transverse crack surrounding a concrete replacement patch, was adopted. In one division, this past season, this method of treating the pavements required 18 cu. yd. per mile.

Mudjacking costs $154 per mile

Cost of the mudjacking was recorded in one division and the following data were compiled: 12,222 holes of 1½-in. dia. were drilled in 61 miles of pavement at a cost of 7c. p hole or about $14 per mile; and 1,0 cu. yd. of slurry were pumped und 61 miles of pavement at a cost of $7. per cu. yd., or approximately $1 per mile, making the total cost for t entire operation $154 per mile of t pavement.

Results obtained by mudjacki during the past three years indica that voids below the slab where fr water might collect can be tempor rily eliminated. However, due to t impact from heavy axle loads and t depth of the muck in the subgra (caused by both free and capillary a tion) the layer of the soil-cem added by mudjacking is not a cure- and generally lacks sufficient thickne to withstand heavy loads for lo periods.

A high percentage of the cra stabilized by the use of a mudjack w in time resume pumping. The wo also showed that after a pavement h broken either at the corners or in half-lane blocks, it is difficult to sta lize the small areas and that the on solution in this case is a replacem patch of concrete.

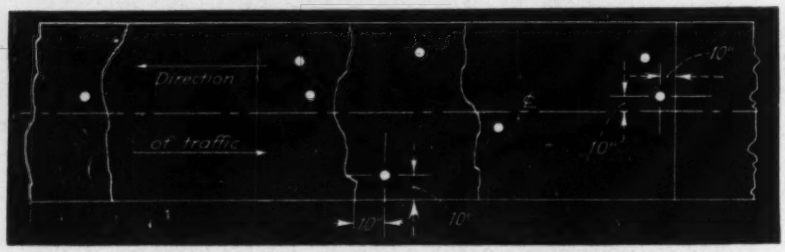


Fig. 3. On most of the mudjacking work to date one hole has been drilled in the slab near the longitudinal joint at each transverse joint and crack. However, on more recent operations added holes located as above have proven worthwhile.

Fig. 4. Badly cracked section of pavement ready for addition of decking, the voids below the slab having been filled with an earth-cement slurry.

Preventive measure only

Based upon this experience, en neers of the Missouri department gard mudjacking as a preventi rather than a corrective measure.

Concluding, that additional work needed to complete the salvage badly damaged concrete pavemen the department sought some e nomical method to waterproof upper surface of the pavement to p vent free water from entering cracks and accumulating below slab.

As an experiment, sections of pavement on Route 66 in Frank County were surfaced with a bitum ous mat. This decking was planned serve two purposes: (1) Aid in wa proofing the surface of the concr pavement that has numerous tra verse cracks, and (2) Restore riding surface of the slab, thereby ducing the impact of traffic, wh is inducive to slab pumping.

The experimental work was a planned to determine, if possible, economical thickness and type of tuminous deck that would prevent reduce the number of cracks p jected from the old concrete pa ment through the deck material. Th different thicknesses were deci

5. A length of decking complete with seal coat is shown in the foreground. The concrete pavement in the background good condition and will not be decked.

on, and the following tabulation set up for the guidance of the sonnel:

1. Ten sections of 2½-in. thickness nging in length from 0.08 to 0.47 iles; total length 1.46 miles.
2. Eight sections of 2-in. thickness nging in length from 0.04 to 0.81 ile; total length 1.73 miles.
3. Four sections of 1½-in. thickness nging in length from 0.04 to 0.58 ile; total length 0.79 mile.

The sections were thoroughly mped" twice by the mudjack crew, g a slurry mix composed of four s of cement per cubic yard of able top soil. The purpose of mud- ing a second time was to make ain that the slab was stable before lication of the bituminous upper . Also, a concrete patching crew owed the mudjack workers, re- ing those areas too severely shat- d to be stabilized by the mudjack cedure.

he twenty-two sections involved in experiment were thoroughly sur- ed by the research department and cracks in the pavement were plot- on a strip map. These data will be d for further reference in the ex- iment.

A 20-man crew adds deck

losely behind the survey party fol- ed the bituminous mat crew, proc- ng and laying the upper deck. A of about twenty men processed material and put down the check- the number of workmen depend- ing upon the operation in progress. They used the following equipment: A mechanical loader, about five 1½-ton trucks to deliver the material to the job, a mechanical broom, at least three motor graders—one for laying and two for processing, a 5-ton roller, an asphalt tank car heater and a distributor.

The aggregate used was dolomite material meeting the following specification:

Passing ½-in. circular screen, 95-100 percent
Passing ¼-in. circular screen, 65-90 percent
Passing No. 20 square-mesh sieve, 15-40 percent
Passing No. 50 square-mesh sieve, 5-20 percent

This material, called chats, is a lead mine byproduct that has proven very satisfactory for bituminous work over a period of years. The aggregate was thoroughly dried.

One 10,000-gal. car of MC-5 asphalt was used on this experiment, but due to the lateness of the season it was not practical to continue the use of this heavy material. For the remainder of the work MC-3 asphalt was used.

Eighteen gallons of asphalt per cubic yard of aggregate was mixed in the windrow and a prime application of 0.15 gal. per sq. yd. was applied on the surface of the pavement just prior to laying the bituminous mat. This made the total bitumen content 20 to 21 gal. per cu. yd. of mat, depending on the thickness laid.

The material was processed on a supplementary road, using the road mix method. It was hauled to the desired location by truck. The mat was laid one-half width at a time with a motor grader, one-way traffic being maintained on the opposite side of the highway. The mat was fully compacted with the 5-ton, three-wheeled, flat roller.

Pavement made wider

To avoid leaving an unfinished edge exposed to traffic during the night, the mat was laid on both lanes of pavement during each day's progress. Also, the material was spread about 6 in. wider at each side than the concrete pavement. This added width helped to seal the crack between the edge of the pavement and the earth shoulder, as well as to provide a water-resistant material at the edge of the pavement to reduce rutting along the slab from shoulder traffic.

After the decked sections had cured, they were sealed with a bituminous material, usually RC-3. Finally, flint or limestone chats were added, which provided an armor for the mat and restored the gray or white surface of the pavement.

The cost of the decking treatment, including the armor coat, was about $4,000 per mile for a 1½-in. compacted thickness.

The salvage work was all performed by maintenance forces of the Missouri State Highway Department under C. W. Brown, chief engineer.

Water Supply Needs—$683 Million!

***Contents in Brief**—One measure of our postwar job in the field of public water supplies is given by the U. S. Public Health Service, which estimates that the elimination of deficiencies will cost at least 683 million dollars. The bulk of this work will be in communities with less than 1,000 population.*

THE COST OF ADDITIONAL water supply facilities needed in the United States is estimated to be $683,300,000, according to an inventory compiled by the U. S. Public Health Service. Of this total, extensions and improvements in 6,455 communities will represent a cost of $502,340,000, and new systems in 4,863 places will call for the expenditure of $180,960,000.

These findings are contained in a report by H. W. Streeter, sanitary engineer director, and Ray Raneri, passed assistant engineer, U.S.P.H.S., published in the Jan. 7 issue of *Public Health Reports* (Vol. 59, No. 1). The report points out that the greatest deficiency in public water supplies exists in the smaller communities having populations under 1,000, as indicated by the following comparison between the total numbers of incorporated places (classified into three groups according to population) and the numbers of these communities served by public water systems:

Population Group	Number of Communities	Number with water supplies
5,000 and over	2,042	2,033
1,000 to 4,999	4,627	4,300
Under 1,000	10,083	4,323

This tabulation shows that more than 99 percent of the communities in the largest population groups (5,000 and over) are served by public facilities and about 93 percent in the middle group, but only 43 percent in the lowest group of less than 1,000 population. Other data discloses that some 10,000,000 people, comprising about 11 percent of the total population served by public supplies, are using water that receives no treatment.

In sketching the present status of public water supplies in the United States, the report points out that public supplies date historically from year 1652 when the first system this kind was instituted at Boston. the end of the year 1800, there 17 waterworks systems in this co try. Fifty more years passed be the systems numbered 100, but 1900 they had increased to ab 3,200 and in 1924 to 9,000. In J public water supplies approxima 14,500 and at the present time estimated to serve about 84,500,0 people, or slightly less than two-thi the entire population of the coun The development of public water s plies within the last half centu has been phenomenal, state Mes Streeter and Raneri, amounting nearly a fivefold multiplication their total number.

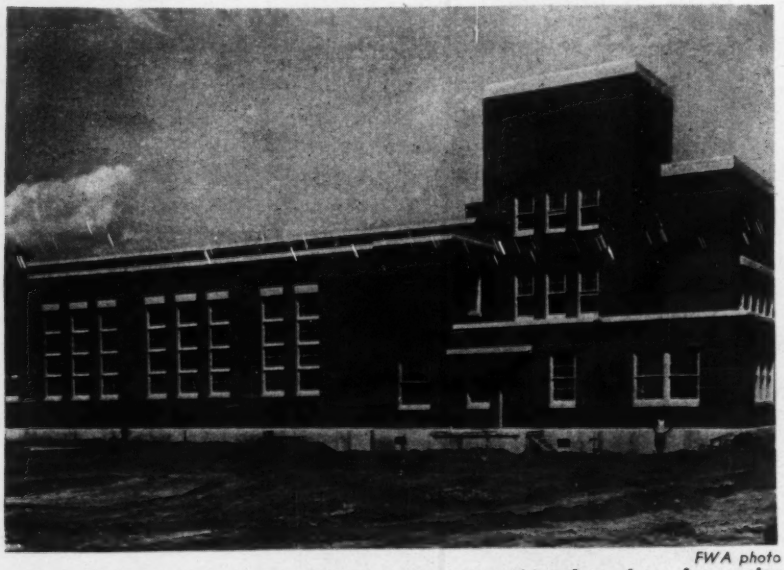
Types of treatment

Although simple chlorination, se ing about 32,400,000 people throu 2,592 plants, is the treatment proc most frequently used, rapid sand fi purification, with 1,754 plants, ser a slightly greater population (ab 33,000,000). Water softening eit alone or in combination with ot treatments, serves about 6,700,0 through 587 plants, of which 4 plants use softening alone or in co bination with iron removal. S sand filter purification serves ab 4,300,000 people through 98 plants.

In order to establish a backgro for estimating the cost of future pr ects, the authors made a study of per capita cost of waterworks proj as reported by the Public Works A ministration in *Publication* No. I This document shows the location, scription and final cost of waterwo constructed by the PWA during t period July 1933 to March 1939.

Method of estimating cost

Altogether 865 PWA projects w listed in four categories—44 in tre ment, 19 in source and treatment, 2 in completely new systems, and 21 groundwater supplies. An analy was then made as shown in Table which gives the relation between a



FWA photo

With municipal construction curtailed by the war, there have been few water treatment plants built during the past two years. The Wilmington, N. C., plant pictured above was one of the few whose completion was permitted to meet the needs of a war-congested area.

ge size of population groups and cor-esponding cost of newly constructed ater supply facilities.

In discussing costs, the authors oint out that following the last war onstruction costs varied considerably ut during the period 1920-30 aver-ged about 12 percent higher than ose prevailing during the war. At e present time, construction costs re about 32 percent higher than in e period 1934-40.

Following the present war, in so far the experience of the last war is a uide, Messrs. Streeter and Raneri elieve it reasonable to expect further crease in cost above the present vels. It is their estimate that costs ter the present war would be about percent higher than in the period 34-40.

In making the cost estimates of fu-re needs, the authors increased the r capita cost indicated in Table I r the period 1933-39 by 32 percent order to conform to present-day ices.

For the derivation of estimated cost extensions and improvements to ex-ing waterworks, a general figure of 5 per capita was used, $20 of which s allotted to source and treatment d $15 for distribution system im-ovements. For purposes of estimat-g total cost, the per capita costs re applied only to the populations be benefited by such improvements d not to the total incorporated pulation figures.

The total estimated cost of addi-nal water supply facilities needed, indicated by present inventory a, is found to be $683,300,000, and distributed as follows:

ew systems....	4,863	$180,960,000
xtensions or im-provements ...	6,455	502,340,000

A distribution of the estimated ds, by states, is shown in the ac-mpanying tabulation (Table II).

Water softening extra

The report points out that the esti-tes given do not include anything the addition of water softening ilities. Of the 27,000,000 people in "hardwater" regions of the United tes only about 7,000,000 are served softened water, and from this it be assumed that roughly 20,000,-people would still need such fa-ies if there were means by which could be provided.

t present cost levels, it is estimated that a water softening plant with filters would cost about $50,000 per 1,000,000 gal. daily capacity. With a mean rate of water consumption of 120 gal. per capita daily, this would represent a construction cost of $6 per capita for softening facilities.

Applied to a population of 20,000,000, the total estimated cost would be $120,000,000 for softening of all water supplies not now thus treated and averaging more than 80 to 100 ppm. in hardness. If this item is added to the cost of needed water supply additions and improvements, it would raise the grand total from $683,300,000 to $803,300,000.

Complete report available

Complete copies of the report from which this material was extracted, are for sale by the Superintendent of Documents, Washington, D. C., at five cents each. Ask for the Vol. 59, No. 1, issue of *Public Health Reports*, dated Jan. 7, 1944.

TABLE I—RELATION BETWEEN AVERAGE SIZE OF POPULATION GROUP AND CORRESPONDING COST OF NEWLY CONSTRUCTED WATER SUPPLY FACILITIES.

(Based on Public Works Administration contracts, 1933-39)

Type of facility	Population range	Number of projects	Average population	Average cost per capita
Waterworks systems (complete, including source)	100–500	246	370	$84.00
	500– 1,000	340	700	65.00
	1,000–10,000	195	1,800	45.00
Treatment works	100– 500	2	384	23.20
	500– 2,000	11	1,130	19.80
	2,000–10,000	23	4,320	15.00
	Over 10,000	8	39,800	9.20
Sources and treatment works combined	500– 2,000	4	1,350	28.40
	2,000–10,000	9	5,320	18.40
	Over 10,000	6	120,000	15.50
Groundwater supplies	100– 500	4	430	16.20
	500– 2,000	12	1,230	7.30
	2,000–10,000	5	3,050	5.28

TABLE II—ESTIMATED COST OF PUBLIC WATER SUPPLY FACILITIES TO MEET REQUIRED NEEDS IN VARIOUS STATES

(In thousands of dollars)

State	Development and purification	Distribution system	Total	State	Development and purification	Distribution system	Total
Alabama	2,420	4,490	6,910	Nebraska	3,640	5,130	8,770
Arizona	3,200	970	4,170	Nevada	80	70	150
Arkansas	3,130	6,400	9,530	New Hampshire	160	280	440
California	41,040	5,710	46,750	New Jersey	3,020	3,630	6,650
Colorado	3,750	1,970	5,720	New Mexico	610	420	1,030
Connecticut	1,320	1,990	3,310	New York	25,300	12,510	37,810
Delaware	280	610	890	North Carolina	4,040	7,820	11,860
District of Col.	6,850	5,150	12,000	North Dakota	3,060	5,200	8,260
Florida	2,760	4,100	6,860	Ohio	23,600	15,510	39,110
Georgia	5,050	7,710	12,760	Oklahoma	5,020	10,260	15,280
Idaho	960	1,960	2,920	Oregon	1,590	1,330	2,920
Illinois	77,600	18,660	96,260	Pennsylvania	24,340	11,800	36,140
Indiana	7,400	8,390	15,790	Rhode Island	9,280	860	10,140
Iowa	3,460	7,210	10,670	South Carolina	1,480	2,770	4,250
Kansas	3,190	5,070	8,260	South Dakota	1,550	1,950	3,500
Kentucky	5,630	6,520	12,150	Tennessee	2,250	3,170	5,420
Louisiana	1,410	4,270	5,680	Texas	8,650	4,490	13,140
Maine	1,110	950	2,060	Utah	2,330	3,530	5,860
Maryland	37,760	9,470	47,230	Vermont	1,080	1,780	2,860
Massachusetts	17,750	3,080	20,830	Virginia	2,390	2,110	4,500
Michigan	33,670	6,600	40,270	Washington	4,070	7,070	11,140
Minnesota	4,240	7,210	11,450	West Virginia	1,670	1,480	3,150
Mississippi	2,110	3,440	5,550	Wisconsin	10,950	10,180	21,130
Missouri	16,590	21,450	38,040	Wyoming	1,680	350	2,030
Montana	230	1,470	1,700				
				Total	424,750	258,550	683,300

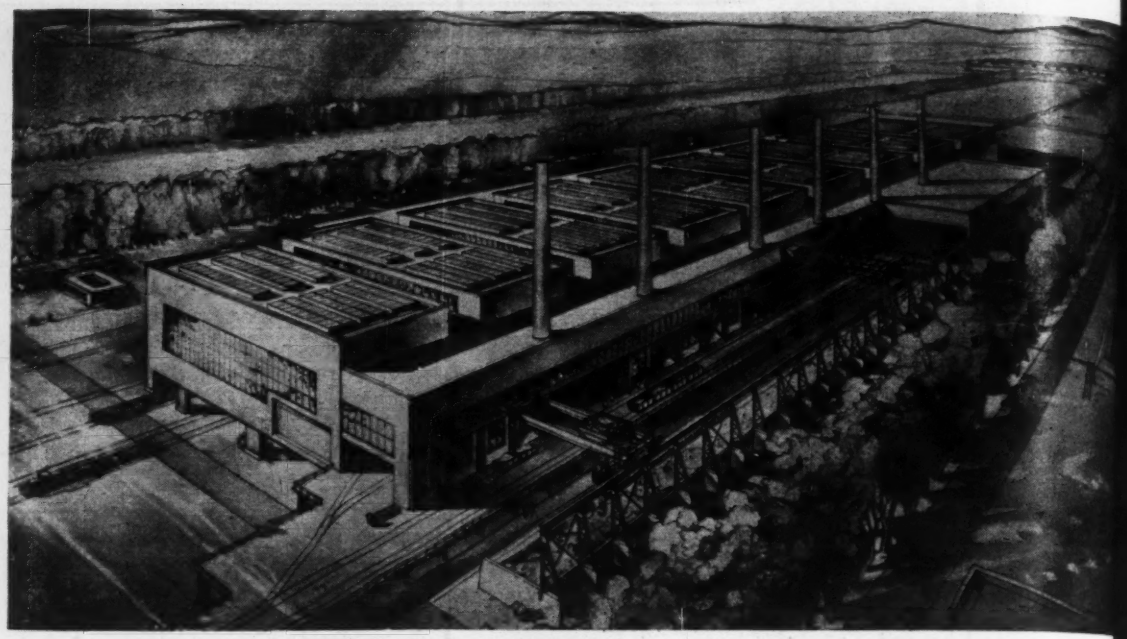


Fig. 1. Architectural rendering of openhearth building of new steel float at Fontana, Calif.

Heavy Steel Frame for Mill Building

***Contents in Brief**—Very heavy loads, including overhead cranes of 125- and 250-ton capacity and charging equipment for 185-ton furnaces, governed the design of a structure housing openhearth steel furnaces at Fontana, Calif. Single row of columns carries the two crane girders. Mass concrete footings used. Some of column base plates weigh 7½ tons.*

ONE OF THE MAJOR STRUCTURES recently completed at the Fontana, Calif., steel mill of the Kaiser Co., was designed to house a group of six openhearth furnaces (each of 185-ton capacity) and their accessory equipment. This building is 390x900 ft. in plan and has a 30x400-ft. approach trestle carrying two standard gage railroad tracks.

The furnace capacity, with allowance for overload plus weight of the ladle into which the furnaces discharge, required that the overhead crane in the pouring aisle have a capacity of 250 tons. In the charging aisle a 125-ton overhead crane was required. One row of columns, the row between these two aisles, carries the ends of the two overhead crane rails. In addition to loads thus imposed, local conditions dictated the consideration of both wind and seismic forces in the design of all structures at this plant.

Over-all dimensions of the openhearth building and the requirements for cranes, spans and column spacings, were determined by furnace layout and operating requirements. The architecture of the building was made to conform to the modern, progressive type used throughout the entire plant that gives particular attention to the best possible ventilation and natural lighting. This resulted in the choice of a monitor type of roof construction and ample use of window sash. Riveted construction was used throughout.

In the central portion of the building (Fig. 2) clearances required in the pouring aisle necessitated a clear height of 56 ft. under the overhead crane. The 17-ft. depth of the roof trusses in this portion of the building was dictated by the clearance requi ments for the repair trolleys, ven tion and architectural treatm rather than by stress considerati To provide for the present and fut additions the building is separated two transverse expansion joints at proximately 400-ft. spacing. A s column with one leg on each side this joint, was provided.

Mass concrete used in place of s

The structural design was in enced greatly by wartime restricti on the use of certain materials. In foundations, for example, mass c crete was used almost exclusively eliminate the need for reinforc steel. Fig. 2 shows essentials of mass concrete footings used under row of columns that is the line of m mon support for the two large o head cranes. The long bolts with wh columns are anchored to the foot were made desirable by lateral longitudinal forces resultant fr braking on the overhead cranes. der the most severe combination forces these bolts would carry full sion loads in the assembly shown

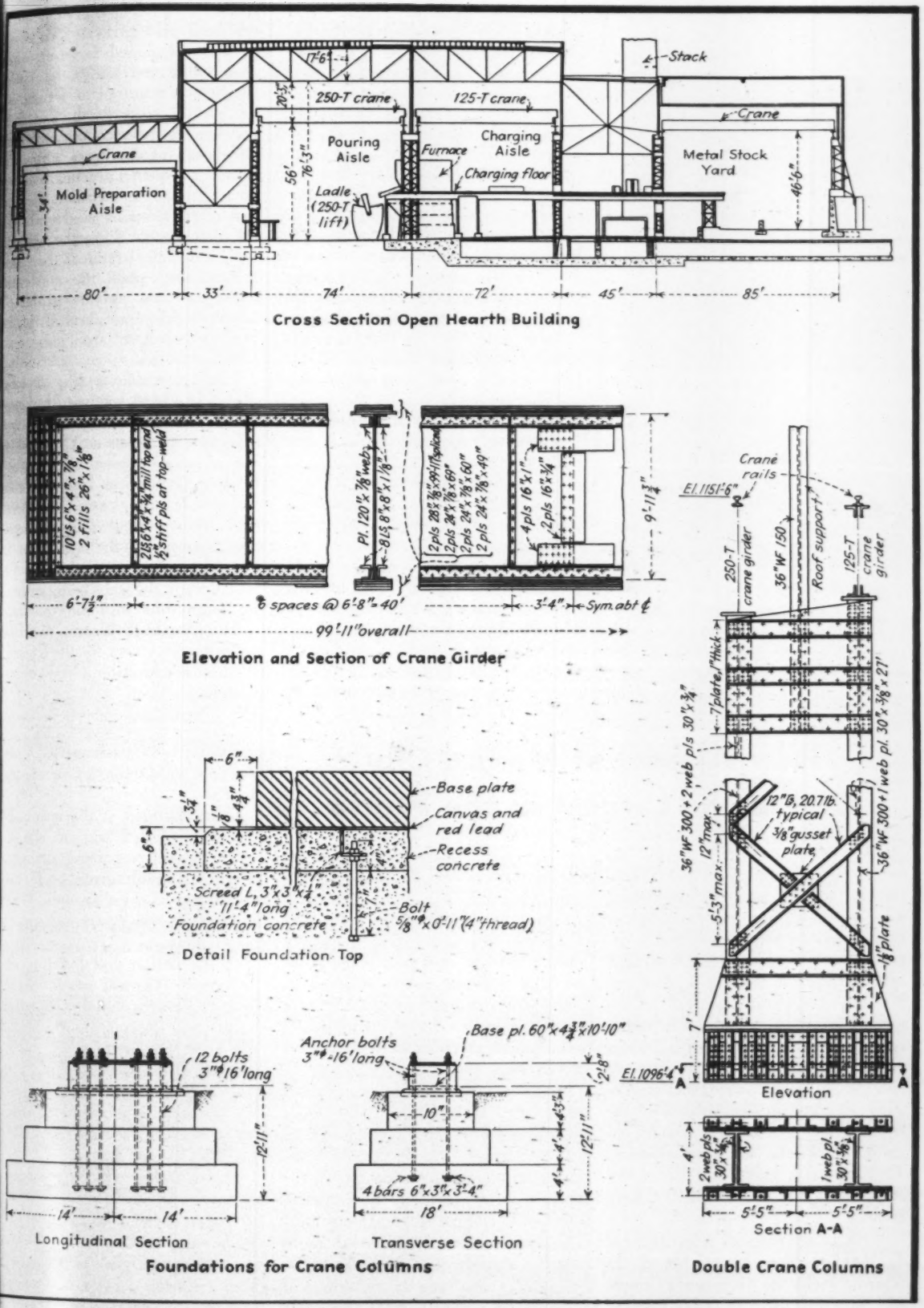


Fig. 2. Structural details of steel float building emphasizing foundations and framing required to support heavy cranes.

Foundation investigations began with obtaining undisturbed soil samples from the site. Laboratory analysis of these showed that a safe bearing of 4 tons per sq. ft. could be used over the major portion of the site. However, there were certain areas where underlying silt lenses would have required special designs to insure against differential settlement of the building. This problem was solved by removing the silt and backfilling either with compacted selected soils or lean concrete.

An interesting problem was presented in the design of the foundation slab under the furnaces and the adjacent building columns. It was found that to consider the superimposed load as uniformly distributed over the entire foundation area and using a continuous slab design, a slab 11 ft. thick was required. However, if, as in the final design, the individual loads were considered as being distributed over sufficient area to keep the foundation pressures under the maximum allowable, with the footings under the bearing walls and columns designed as isolated elements tied together by the rest of the slab, a slab only 4 ft. thick was sufficient over most of this foundation area.

Some of the heavier base plates weighed as much as 7¼ tons. The method of setting is illustrated in Fig. 2. The grout pad was poured in a recess left for this purpose in the first pour, and was leveled by the use of embedded screed angles adjusted to elevation on bolts also set in the first pour.

To provide against local concentrations due to imperfection of contact surfaces the base plates were placed on a film of red lead and canvas. The heavy building column foundation, of which details are shown in Fig. 2, carried, in addition to the crane loads, the roof structure for a 730-sq. ft. area.

In order to effect a further saving in steel, a reinforced concrete slab in place of the usual steel plates supported on closely spaced floorbeams was used over as much of the charging floor area as was feasible. A steel plate floor was used only in the areas immediately adjacent to the charging doors of the furnaces where there is possibility of molten steel being spilled.

In the short time allotted to the design of this structure, comparative studies were made for several elements of the building. Due to the scarcity of steel plates, a study was made of the possibility of carrying the heavy cranes over the 100- and the 75-ft. spans on trusses instead of on the conventional plate girders. This possibility was abandoned, however, when it was found that additional building height was required to accommodate the greater truss depth, and that to provide for the secondary stresses in the design of this truss with its stiff members required practically the same amount of plate to frame the chords and connections as was required for the plate girder. Since the trusses did not materially reduce the use of critical steel plate the conventional and practical plate girder was adopted. Principal parts of the crane girders selected are indicated in Fig. 2.

The transverse system of bracing shown in Fig. 2 was used to keep the bending stresses in the columns to a minimum and thus make possible the use of rolled beams, eliminating the necessity of using built-up column sections. In many cases rolled sections with webs thinner than allowed by specifications of the American Institute of Steel Construction were used for columns, the webs being reinforced by longitudinal stiffening angles.

The Donald R. Warren Co. was the consulting engineer for the Kaiser Co., Inc., on preparation of the structural designs.

New Airport at Mexico City One of the Largest in the World

Mexico City, one of the busiest air centers in the Americas and a vital link in the vast, growing network of inter-American air transportation, is soon to have a new airport that is expected to be one of the largest and best equipped in the world. Work on the new Aeropuerto Central, as the airport has been named, was begun recently by the division of buildings of the Secretariat of Communications and Public Works, as part of a nation-wide program to give Mexico all the landing facilities needed for its expanding military and civil aviation. The airport is being built on a site adjacent to the present Mexico City airfield.

With an area almost twice as great as that of New Yorks famed La Guardia Field, the Aeropuerto Central will have five main runways ranging in length from 5,740 to 8,200 ft., and several smaller runways. Each of the main runways will be about 130 ft. wide.

The great length of the main runways will solve a problem frequently encountered by transport plane pilots at high altitudes, such as exist at Mexico City, where lean fuel mixtures produced by the rarified atmosphere make longer takeoffs necessary than at lower levels.

Besides a passenger terminal, which is reported to be capable of holding 80,000 persons, the new airport will have freight terminals for domestic and international service, a 900-car parking area, customs, immigration and health offices, stores, restaurants, postoffice, meteorological and radio stations and many other facilities for efficiently expediting the movement of passenger and express traffic. Builders of the field estimate that it will be able to handle 1,000 passengers, 24 tons of baggage and 20 tons of air express an hour.

Other features of the terminal will include complete repair shops for servicing and repairing planes, and twelve mammoth turntables for swinging transport ships around. The field will have its own power and water supply systems.

In the design and building of the Aeropuerto Central special problems have been encountered which are unique to the topography and soil of this area. One of them was drainage, because of the flatness of the ground on which the field is to be located, which makes it almost impossible to carry away surface accumulations of water by gravity flow.

The problem is being solved by draining the whole area, so that any part of it, paved or unpaved, can serve as a safe landing field. Moreover, steps are being taken to neutralize the high saltpeter content of the soil so that the airport may be planted with grass.

Los Angeles Freeway Plans Feature Four-Level Grade Separation

DESIGNS FOR AN IMPROVED TYPE of freeway intersection have been adopted for a location in downtown Los Angeles where the main thoroughfare from San Francisco to San Diego crosses the Arroyo Seco Parkway route from Pasadena through Los Angeles to the harbor at San Pedro. This intersection, on the westerly fringe of the Los Angeles civic center area, will have the heaviest through and local travel on the city's parkway network and, hence, the design was worked out with great care. A cloverleaf would not have been desirable because a major percentage of the traffic makes right-angle turns at this intersection. The result is said to be "an entirely new type of grade separation and interchange system" whose four levels increase safety, reduce traffic confusion and decrease travel distances.

At the site selected for this important intersection the topography lends itself to the four-level idea. The No. 1 level, about 22 ft. below natural ground surface, was fixed by the fact that this is the lowest level from which gravity drainage could be discharged into the storm drain sewer. The second level, used by the Arroyo Seco Parkway, will be at about ground surface. The third level will be elevated similar to an ordinary overpass, while the highest level, the Hollywood Parkway, will be on a supported grade with a smooth profile meeting the higher ground on each side.

The topography at this site favors this arrangement and makes possible a natural and pleasing effect. Roadways on the several levels over the spot where the center lines are superimposed will be carried by a nine-column reinforced concrete structure extending from the foundation to the highest level. Minimum vertical clearance for all roadways will be 15 ft. and minimum horizontal clearance between curbs and columns of the central supporting structure will be 2 ft. on the driver's side and 4 ft. on the opposite side.

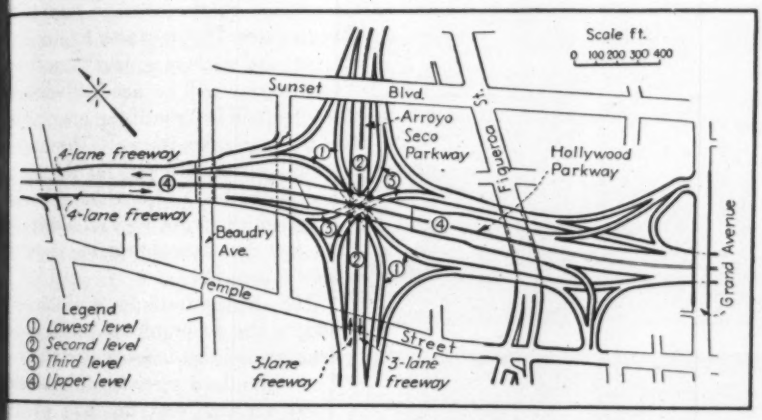
Exchange and connecting roadways have curves with a minimum radius of 300 ft., while the grades vary from nearly level to a maximum of 8.5 percent. On Arroyo Seco Parkway there is a short stretch of 4.5 percent grade which is the maximum for either of the main routes. These standards meet requirements for 60 m.p.h. on the parkways and 35 m.p.h. on the interchange roadways.

Level 1 provides for two 24-ft. one-way roadways connecting Arroyo Seco and Hollywood parkways. Level 2 is the Arroyo Seco Parkway, a six-lane freeway with a median strip. Level 3 is for the two 24-ft. one-way roadways connecting Hollywood and Arroyo Seco parkways. Level 4 is the Hollywood Parkway, an eight-lane freeway with a median strip.

The central bridge structure has a height of 69 ft. (above the lowest roadway), of which about 47 ft. will extend above the natural ground surface. By careful arrangement of cut and fill, mostly on slopes of 2:1, it has been possible to provide for landscaping much of the area that is not paved.

Use of retaining walls could not be entirely avoided but probably none will exceed 20 ft. in height. The project as laid out will remove old and outmoded buildings, in many cases in disrepair, and the general appearance of the neighborhood will be greatly improved when the work is finished.

The comprehensive preliminary studies on this project are under supervision of the California Division of Highways, for which S. V. Cortelyou is district engineer at Los Angeles. W. H. Irish, district location engineer, first suggested the four-level scheme. Development of plans has been carried on in cooperation with the Los Angeles city engineering department. Although designated as "parkways" in the city's network, these main routes are actually freeways under the state law.



An intersection design whose objective is more safety with less travel and flatter curves. The levels at which the roadways cross are indicated by numerals.

Rough model of the four-level intersection to show arrangement of roadways.

Rapid and Simple Concrete Proportioning

L. D. Long
Newark Testing Laboratories, Newark, N. J.

***Contents in Brief**—Concrete proportioning is reduced to use of simple empirical charts that enable the inspector or engineer not familiar with concrete technology to take unknown aggregates and design successful mixes. With specific gravity known, only a set of standard screens is needed in addition to the four charts shown. The Department of Public Works of the City of New York has adopted and endorsed the method.*

TO GET CONSISTENTLY GOOD CONCRETE it is necessary for the inspectors in the field, the last controlling influence between design and reality of construction, to be able to produce a workable concrete mix. The necessity for meeting this requirement led to the development of a method of concrete design, scientifically correct, but simple enough to be quickly mastered by reasonably intelligent, non-technical men in the field. Use of the scheme requires only "mechanical" understanding of four simple charts, the specific gravity of the material to be tested, and a set of laboratory screens for determination of the fineness modulus.

The average engineer or inspector seeking information for use in obtaining more scientific concrete has quickly become convinced that the concrete technicians have developed a world of their own with language and techniques foreign to him. Thus it becomes clear why the non-scientific, often inapplicable, 1:2:4 concrete mix still is accepted, even specified, by architects and engineers. The method here described has been worked out to enable non-technically trained field men to design a mix, simply and with the greatest degree of efficiency, governed only by the actual working conditions on the job.

Fineness modulus of aggregates is one of the fundamental tools of this method of concrete design. This is a scale of numbers that increases or decreases according to what may best be described as the average size of the aggregates. If the coarse aggregate is large, the surface area is small, and less mortar will be needed, while the reverse will be true if the average size of the aggregate is small. The fineness modulus was adopted for the simplified method of proportioning because of its simplicity, proven reliability and the fact that it is obtainable from regular screen tests.

The fineness modulus is obtained by adding the accumulated totals of percentages of the amounts retained on U. S. Standard screens, or equivalent Tyler screens, and dividing by 100. Naturally the screens must always be in numerical order and progressive sizes as listed below:

Retained on screen	Fine Agg.	Coarse Agg.
100	95	100
50	80	100
30	55	100
16	30	100
8	7	100
4	0	95
⅜		75
¾		45
1½		5
3		0
	267	720
Fineness Modulus	2.67	7.20

Best understanding of the charts and their use may be obtained by following through the design of a specific mix. The charts were prepared by the

FORM 1—USED FOR MIXES WHERE STRENGTH OR WATER-CEMENT RATIO IS SPECIFIED.

Gallons per bag *5.5*; Psi, *4,000* — Agg. parts per bag *7* — Slump *3* to *5* in.

Aggregates

	F.M.	Sp. Gr.	Wt. Cu. Ft.	Source
Fine aggregate	*2.67*	*2.63*	*105.1* Wt.f	*Sand*
Coarse aggregate	*7.2*	*2.62*	*107.8* Wt.c	*Gravel*

Using Chart No. 1

A = percent voids in fine aggregate		A = *35.9*
B = percent voids in coarse aggregate		B = *34.0*
X = percent solids in fine aggregate	X = 100 − A	= *64.1*
Y = percent solids in coarse aggregate	Y = 100 − B	= *66.0*

Using Chart No. 2 or 2A

		C = *5.5*	D = *5.06*
C = Gallons water per bag		E = *1.77*	E = *1.77*
D = Added parts f. & c. aggregate		X = *.64*	F = *3.29*
E = 35 percent of D (gravel) 40 percent of D (stone)		EX = *1.13*	Y = *.66*
F = D − E		FY = *2.17*	FY = *2.17*
G = Aggregate solids per bag of cement (EX + FY)		G = *3.30*	

Using Chart No. 3

H = Bags cement per cu. yd.			
W = Gallons water per cu. yd. (HC)		H = *5.97*	H = *5.97*
V = Added cu. ft. aggregate per cu. yd. (HD)		C = *5.50*	D = *5.06*
R = Max. water retained in cu. yd.	R = *55.47*	W = *52.8*	V = *50.2*

Using Chart No. 4

		V = *50.2*
J = Cu. ft. of C. aggregate per cu. yd.		J = *20.2*
K = Cu. ft. of F. aggregate per cu. yd.	J = *20.2*	K = *10.0*

Design Mix (One Cu. Yd.)		Check Yield	
H (cement)	− *5.97* Bags	H × .48	= *2.865*
K (f. aggregate)	− *10.00* Cu. ft. × Wt.f = *1,051*	K × X	= *6.410*
J (c. aggregate)	− *20.20* Cu. ft. × Wt.c = *2,177* lbs.	J × Y	= *13.332*
W (water)	− *52.8* Gallons	R or W ÷ 7.48	= *4.385*
		Cubic feet of concrete	*26.992*

(Note: In checking yield use R or W whichever is smaller)

(Form 1 and 2 are copied from those used by the City of New York—Department of Public Works—Materials Section)

thor for use of non-technical junior spectors in the field. The scale of engths on the charts for gravel and stone is very conservative and may increased as much as 500 psi. when ncreting operations are under strict trol.

The forms here shown are those d by the Department of Public rks of the City of New York. Form s used when the specifications re- ire minimum strength, water- ent ratio or aggregate proportions bag of cement. Form 2 is used en the requirements are for a fixed ount of cement per cubic yard.

Simple mix design

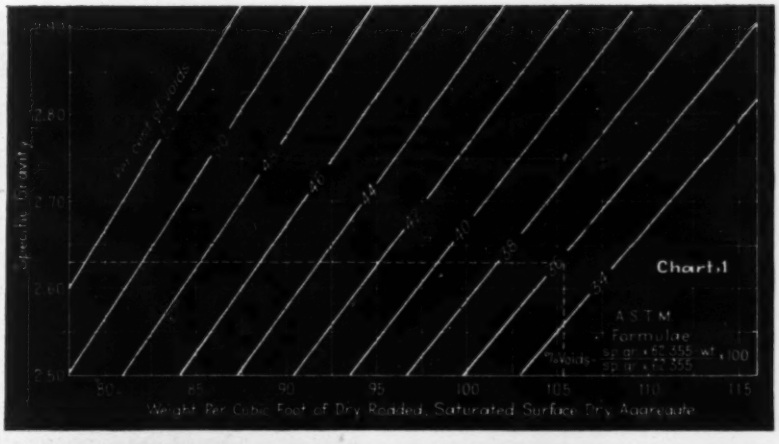
On Form 1, which will be taken as example, a 4,000 psi. concrete with naximum of 5.5 gal. of water per of cement and a slump of 3 to 5 is specified, with available sand gravel aggregates having the char- eristics shown.

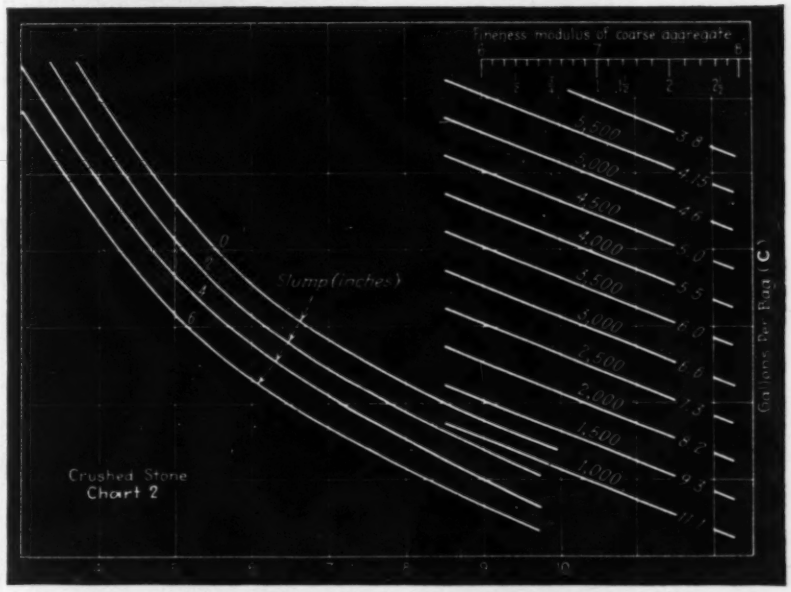
First requirement is to obtain the cent of voids in the fine and rse aggregates, respectively, which be computed from the specific vities and the weight per cubic foot dry rodded, saturated, surface-dry regate. However, Chart 1 is in- ed to make it possible graphically find the percent of voids without culation. For sand with a specific vity of 2.63, follow dotted line to rsection with vertical 105.1 weight , indicating 35.9 percent of voids, ich is entered as A on Form 1; ds in the gravel are obtained simi- y. By subtracting the percentage of ds from 100 the percentage of ds is obtained.

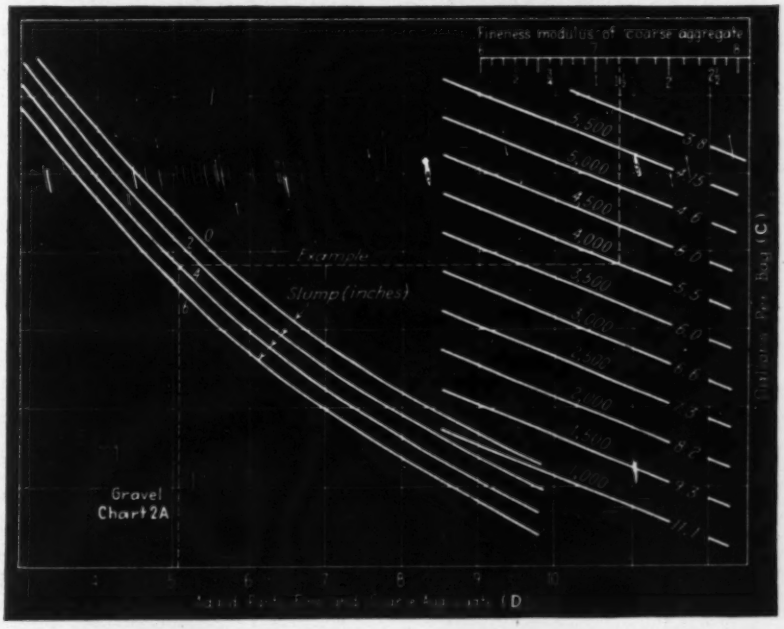
Chart 2 and 2A for crushed stone gravel respectively, provide a phical means for determining one four factors when the other three known.

1. Added parts of fine and coarse aggregate per bag of cement (1:2:4=6 or 1:3:5=8). It may be specified or found.
2. Slump. Specified or selected.
3. Water-cement ratio or strength. Specified or found.
4. Fineness modulus of coarse aggregate. Known from test.

rt 1. Is used for determination of centage of voids in fine or coarse regates without computations. rts 2 and 2A are used for deter- ation of amount of combined fine coarse aggregates that may be ed per bag of cement, slump in or gallons per bag.







For the problem at hand, the slump and W/C, are known and the added parts of fine and coarse aggregates is to be determined. Enter Chart 2A with the F.M. of the coarse aggregate, 7.2, at the upper right hand corner, following a vertical line to the diagonal line marked 4,000 psi which corresponds to 5.5 gal. of water per bag of cement or W/C of 5.5/1. Enter 5.5 on Form 1. Follow the example line horizontally to the selected slump of 4 in., which it will be noted intersects, at 5.06, a vertical line to "added parts of fine and coarse aggregate" and the figure, 5.06, is duly entered at D.

Next operation is to determine the amount of sand and of gravel separately in the 5.06 parts of aggregates per unit of cement. The sand is assumed to be 35 percent of the total or $5.06 \times 35 = 1.77$ (E on the Form) and the gravel the remainder or 3.29(F). Hence the mix becomes 1:1.77:3.29. The sand is 64 percent solids (X on the Form) and the gravel (Y) is 66 percent. E×X equals 1.13, F×Y equals 2.17 or total solids in aggregates per bag of cement is 3.30 (G on the Form). Design of stone concrete mixes is similar except that Chart 2 is used and 40, rather than 35 percent, sand.

Use of Chart 3

The five vertical scales shown on Chart 3 represent solid values of the ingredients in a concrete mixture. All values are placed in relation to each other on any selected horizontal line and are used in this manner as constants except the water scale, which sometimes is less than the value shown.

(G) The added percent of solids for the fine and coarse aggregates per each bag of cement. Calculated and added as shown in example on Form 1.

(H) Bags of cement per cubic yard. Found on horizontal line opposite value found on scale (G) when using Form 1. This amount increases when water used is less than the maximum amount the mix will carry, but never decreases. This scale also is used when the bags per yard are specified as on Form 2. Exceptions are explained below.

(L) Total aggregate solids per cubic yard. It is the result of multiplying any amount on scale (G) by the corresponding number of bags on scale (H) and is used only with Form 2.

(rR) The amount shown on the r side of this scale is the maximum

Chart 3. For determination of bags of cement, total aggregate solids and water per cubic yard.

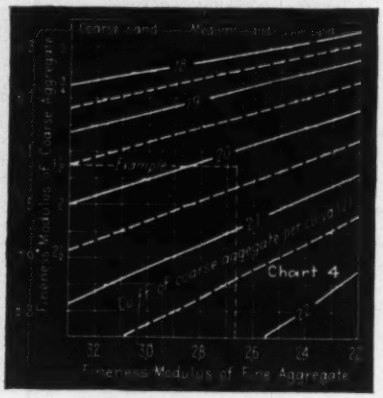


Chart 4. For determination of the cubic feet of coarse aggregates required in a cubic yard of concrete with varying fineness moduli of both fine and coarse material.

(rR) water that will be retained in any mixture by each bag of cement. On the R side is the corresponding number of gallons in a cubic yard of concrete. The r numbers are used only as a check against the amount of cement to be used per yard of concrete. The R side is used on Forms 1 and 2 with the values taken on a horizontal line for the correct amount of cement per cubic yard.

The scale at the right shows the cubic feet of water equal to the corresponding gallons per yard on scale (R) and is merely a convenience in checking the yield.

Returning to the specific mix being designed, the next step is to determine H, the bags of cement required per cubic yard. On the scale marked aggregate solids per bag of cem which was just found to be 3.30, d a line from this point to the ver scale r, maximum water per bag cement, in this case 5.5. Where scale intersects the vertical scale "B cement per cu. yd." the value 5.97 H is found and entered on the form two places. R, maximum water can be retained per cubic yard found by drawing a horizontal from the value found for H (5. giving here 35.47. Multiplying H (which gives W, maximum perm sible water in the mix per cu. yd. concrete) the product is 32.8 well under the amount the mix retain. H×D (bags of cement per yd. times the added parts of sand gravel) equals V the total aggre in the mix. (In some cases the connecting scales G and r will be d onally downward. When this occu proper reading will be obtained making the G-r line horizontal. A the chart, and reading H in that p tion).

The relative amounts of coarse fine aggregates vary only with cha in the average size of the particles indicated by the fineness modu The horizontal scale of Chart graduated for fineness modulus coarse aggregate, and the ver scale for fine aggregate. For the under discussion a horizontal from 7.20 and a vertical line fr 2.67, fineness modulus of the res tive aggregates, intersect at 20.2 w is the cubic feet of gravel required the mix and is J on the Form. total sand and gravel in the mix 20.2 leaves 10 cu. ft. for sand.

Weights of materials for a batch obtained by simple multiplicatio quantities of cubic foot units alre determined. Yield of the batch ca checked by multiplying the quanti of each ingredient by its solid ume. For water, the maximum per ted under the specification or the m imum that will be retained in the c crete, whichever is less, is used.

When the cement content of a b is specified the same charts are u but in a 1, 4, 3, 2 order. The proce can be easily followed by check against the Form 2 shown.

General information

Many factors enter into a good crete mix. Aggregates should be c and durable. Being clean does

cessarily mean completely free from , dust or finely divided clay. It is ly necessary that no material be esent that will form a coating over aggregate particles and prevent or aken the adherence of the cement ste; nor that foreign material be esent in such quantity as to detract m the strength or durability of the crete. Standard tests and require- nts for aggregates are covered arly in most specifications.

Both fine and coarse aggregate ould be well graded to obtain the est possible amount of voids, and maximum size of the coarse aggre- e should be as large as placing con- ions will permit. The greater the rage size of the coarse aggregates, less mortar will be needed to coat the particles. Trial batches are ad- able to learn the particular charac- stics of various local materials, e of which may prove to have a face texture to which cement paste have a greater or lesser bond.

Concrete mixture design

Workability of the concrete prob- is its most important feature so as work in the field is concerned. most workable concrete, that is t easily handled, is mortar. Eco- ically the mortar must be reduced uch as workability will permit and ition of coarse aggregate must stop at point.

o attempt has been made in the rts to differentiate between types material except as their size and e affect the workability of the ture and the amount of water re- ed per bag of cement. The cement e or glue holding the aggregate ther controls the strength of the rete. The more watery or the ner this paste is made the less gth the concrete will have. It is, fore, imperative that efforts be e to use the cement paste in its concentrated form.

ch grain of sand must be coated pushed apart from every other by the cement paste. Every par- of coarse aggregate must be sepa- from every other piece by a bed ortar (cement paste and sand) hus carried or floated into place ut wedging of the coarse par- to cause harshness.

arse sand will require less cement than fine sand but must be used eater quantity to maintain work- y, for just as a thinner joint may be made between brick with fine sand mortar and a thicker one is needed for coarse sand, so the same principle will be true for the particles of coarse aggregate. This adjustment is made with the aid of Chart 4.

Other desirable features of concrete, such as slump and strength, are obtained by varying the proportions of sand, cement and water used in making up the mortar.

For mass concrete and pavements with a thickness of seven inches or more it will generally be possible to increase the coarse aggregate from 0.3 to 0.5 cu. ft. and decrease the sand by the same volume. For thin, heavily reinforced walls or slabs, especially when hand spaded, it may be necessary for the coarse aggregate to be decreased by about the same amount and the sand increased.

Under this system of design the excess water that often is apparent in wet concrete, rising to the top during placing, is not considered as concrete but as extra lubricant that is carried along. The amount of water that can be considered as volume is determined by the amount of cement used and has been calculated from Chart 3.

The author is indebted to W. S. Elliot, chief of the materials section, Department of Public Works, City of New York, for his help in preparation of this description.

FORM 2—USED FOR MIXES WHERE CEMENT CONTENT IS SPECIFIED.

Bags of cement per cu. yd. 5(H) ..... Slump 4

Aggregates

	F.M.	Sp. Gr.	Wt. Cu. Ft.	Source
Fine aggregate	2.60	2.63	103.3 (Wt.f)	L.I. Sand
Coarse aggregate	7.4	2.82	102.0 (Wt.c)	Cr. Stone

Using Chart No. 1

A = percent voids in fine aggregate	A = 37.0
B = percent voids in coarse aggregate	B = 42.0
X = percent solids in fine aggregate	X = 100 − A = 63.0
Y = percent solids in coarse aggregate	Y = 100 − B = 58.0

Using Chart No. 4

J = Cu. ft. coarse aggregate per cu. yd. ..... J = 20.7

Using Chart No. 3

L = Aggregate solids per cu. yd.	L = 20.00
M = C. aggregate solids per cu. yd. (JY)	M = 12.00
N = F. aggregate solids per cu. yd. (L − M)	N = 8.00
K = Cu. ft. F. aggregate per cu. yd. $\frac{(N)}{X}$	K = 12.70
R = Max. gallons retained in cu. yd.	R = 34.5

Using Chart No. 2

D = Added parts F. & C. aggregate per bag (J + K) ÷ H or 2A	D = 6.68
H = Bags cement per cu. yd. (specified) H	
C = Gallons water per bag	C = 7.2
W = Total gallons per cu. yd.	W = 36.0
P = F. aggregate correction (R − W) × (.21)	P = 0 + K = 12.70 (Ka)

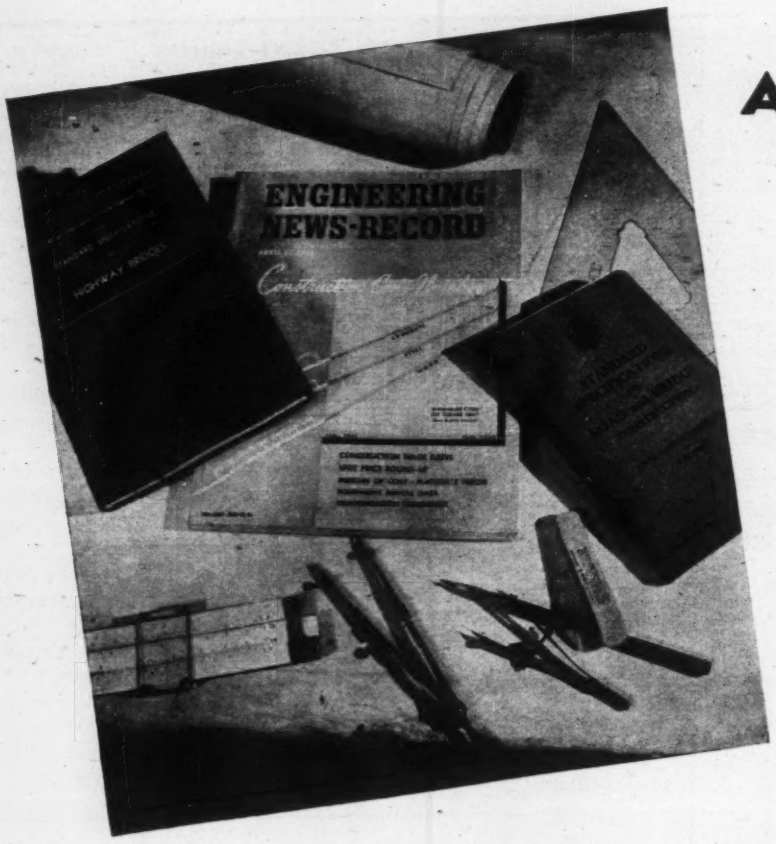
(When W is equal to or greater than R no correction is made)

Design Mix (One Cu. Yd.)			Check Yield	
H (Cement)	= 5 Bags	× 94 470 lbs.	H × .48	= 2.40
Ka(f. aggregate)	= 12.70 Cu. ft.	× Wt.f 1,312 lbs.	Ka X	= 8.001
J (c. aggregate)	= 20.70 Cu. Ft.	× Wt.c 2,111 lbs.	J × Y	= 12.006
W (water)	= 36.0 Gallons		R or W ÷ 7.48	= 4.612
			Cu. ft. of concrete	= 27.019

(Note: in checking yield use R or W whichever is smaller).

TABLE I—APPROXIMATE CHARACTERISTICS OF MATERIALS, USABLE FOR EMERGENCY DESIGN, UNTIL ACCURATE DETERMINATION CAN BE MADE.

Type Material	Specific Gravity	Percent Voids	Percent Solids	Weight Per Cu. Ft.
Cement	3.14	52	48	94
Sand	2.63	35	65	106.6
Round gravel	2.63	35	65	106.6
50 percent crushed gravel	2.63	38	62	101.6
100 percent crushed gravel	2.63	40	60	98.4
Trap rock	2.90	45	55	99.5
Dolomite	2.80	43	57	99.5
Limestone	2.70	40	60	101.0
Granite	2.75	43	57	97.8
Gneiss	2.71	43	57	96.5
Basalt	2.95	45	55	101.0



A 7-Point Pl

Earl L. F. Porter
Civil Engineer and Specifications W
St. Paul, Minnesota

GOOD SPECIFICATIONS can be written, but three important factors are involved. These are: (1) The specifications writer must have complete and correct data; (2) he should have a "follow-through" contact with the construction work; and (3) a common code of fair practice on the part of engineers and contractors in the interpretation of specifications must exist.

Without attempting to formulate an all-inclusive definition of a specifications writer, it can be said that he is a "coordinator and editor of engineering ideas." He cannot be a specialist in all branches of engineering. If he knows where to get the necessary information and how to assemble it in coherent and understandable form, then he is no mean engineer. For example, it is not for the specifications writer to decide if forms should be oiled prior to the placing of concrete. That decision belongs to the province of either the design or construction engineer. The specifications writer edits the decision in proper words and space in the specifications.

The specifications writer must have adequate technical background and wide field experience. Also, he must be conversant with the codes and standards of national engineering organizations. But no matter how profuse his knowledge or how varied and apparently complete his construction experience, he is not self-sufficient to the task of writing the specifications for any sizeable engineering project. He must reach out and go abroad for much information. The grand plan and the bulk of the necessary details are obtained from the project design engineer. These data, together with the standards and reference library, coupled with his own reservoir of knowledge and experience, provide the specifications writer with perhaps 80 to 90 percent of the material that goes into the specifications.

The remaining percentage, comprised of scope and polish, must be added if the specifications are to be complete. Scope can be attained by participating in conferences, site tours, preliminary investigations, and experimental work carried on in connection with the formulating
processing of plans and specifica
for the proposed project, and by
ing followed up on previous spec
tions through close contact with
construction work. Polish can be
tained by direct consultation with
gineering and artisan personnel in
specialized fields, such as, earth
ing operations of various kinds,
protection work, dredging, pile
ing, foundations, concrete cons
tion, shop and foundry work,
fabrication and erection, weld
painting, timber work, electrical
contract procedure, legal quest
and similar subjects.

Writer must be resourceful

As to the actual work of compi
and editing the assembled mate
there is a lot more truth than fi
in the statement, "Specifications
an engineer's dream." How else
there be coherence and orderly
quence in specifications except by
ualizing the project in its entir
The specification engineer lacking
aginative capacity is as destitut
the construction engineer una
that you must have forms before
can pour concrete.

Writing specifications is a la
ous and exacting task, but it is
drudgery. Every engineering or
zation strives for a high standar
construction in the various public
private enterprises entrusted to its
velopment, and it is the obligatio
the specifications writer to be rig
material and workmanship req
ments according to the standard
Many a lethargic high school stu
has wished to himself that Ne
had never been born so that he
have been spared the drudgery
memorizing the three laws; they
not even a "necessary evil" to l
Specifications introduce new mate
and advanced practices, consequ

Achieve More Satisfactory Specifications

1. Specification writers should have adequate technical training and field experience . . . 2. They should visit jobs after construction starts . . . 3. Criticism from owner's staff and contractor's engineers should be invited . . . 4. Question of tolerances should be left to field engineers . . . 5. Use of stereotyped phrases should be avoided . . . 6. Broad viewpoint in interpretation should always be followed for best results. . . . 7. A code of interpretation should be developed.

is not to be expected that they shall understood and followed without pending some effort.

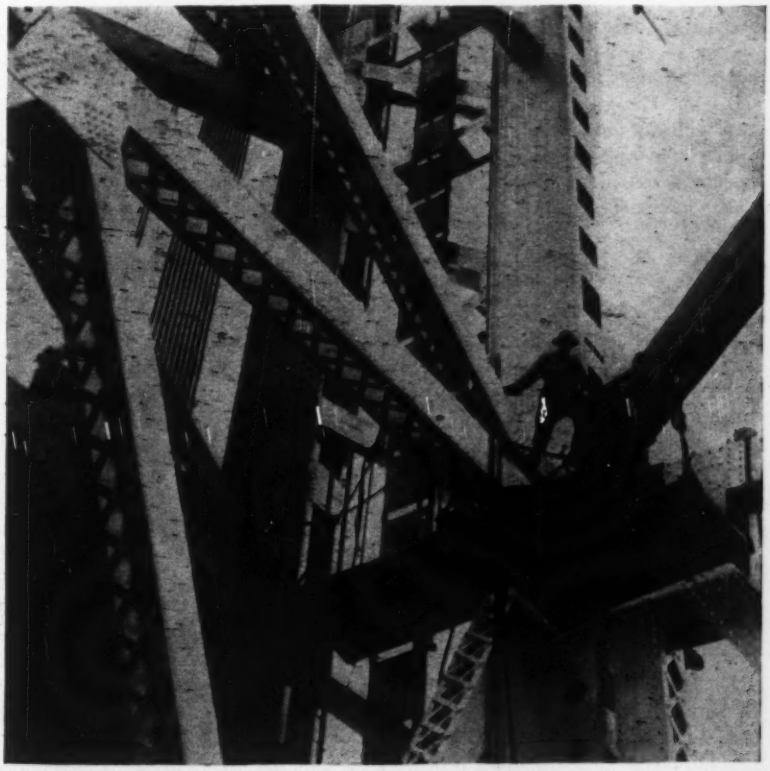
Is there a specifications writer so rtunate that he has the opportunity travel along with his finished prodt as it passes through the various ases of bidding, contracting, conruction, and later on, the use or opation of the completed project? The stomary routine is to kiss the spefications goodbye after the last stenl sheet has been proofread, and then tight. If the specifications are good, ir, or poor, the writer hears nothg; only if they are extremely bad, obviously in error, is he brought to contact with them again. It is not ough that the specifications writer permitted to make one or two casl trips to the construction scene; he ould live there three or four days, week or two, at a time.

Writer should visit job in progress

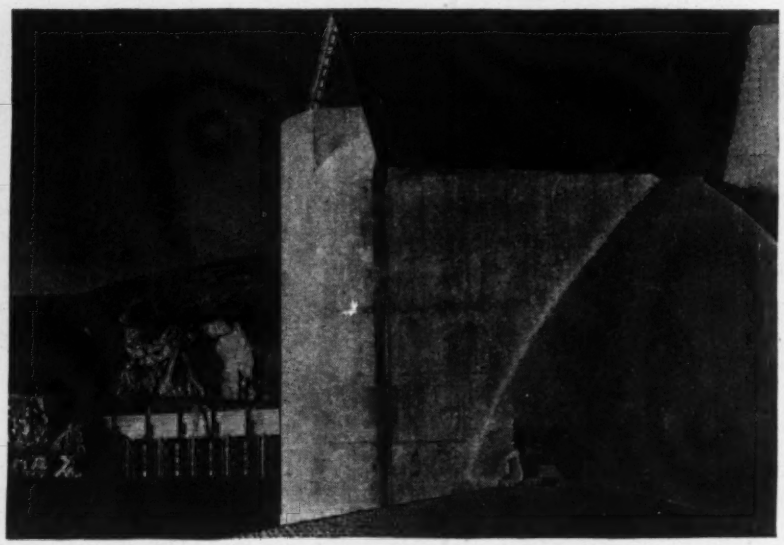
A common practice in many engier departments is to require finished uctural drawings. Why not fined structure specifications also? It not necessary to burden the field ganization with the extra work of bmitting a carefully prepared reort, but one copy of the specifications ould be designated for free coment every individual connected with field office. A copy of the specificans, damned or praised from cover cover with pencil note comments by eryone from the most inexperienced pector to the most seasoned engier, would be more valuable than a rmal typewritten report on the subt. Why not go further and invite the ntractor to mark up a copy without lling any punches? He perhaps uld gain some solace to know that person who wrote the ignoble docent would, at least, learn the conctor's opinion thereof. The specifiions writer could then play the role of diagnostician, and could perhaps concoct some potions of soothing balm to be substituted in place of the irritants that invariably infest the pages of specifications.

Leave tolerances to field engineers

In the matter of tolerances, it is doubtful that any general agreement could be arrived at among engineers and contractors as to what part of the work should be tied down to tolerances and what those tolerances should be. Except for standard practice in showing machine tolerances on drawings and the inclusion of tolerances contained in engineering standards and codes for specialized work, the introduction of general building and construction tolerances in specifications is likely to meet with much disfavor from both field engineers and contractors. Field engineers often feel that they are bound hand-and-foot by restrictions and regulations emanating from the central office, and to litter the pages of specifications with tolerances to be adhered to in the placing of every piece of riprap, guard post, concrete pour, and steel beam, is a blunt way of treating them as intellectual paupers.



The matter of tolerances for intricate steelwork should be left to the field engineer. The inclusion of rigid tolerances in specifications is a blunt way of treating field men as intellectual paupers.



Writing specifications for such mammoth structures as Grand Coulee Dam require men with thorough technical training and years of field experience.

Trouble on the job is perhaps more often the result of a clash of personalities engendered by disagreement over trivial questions of engineering, rather than the result of faulty specifications. The panacea is not, for example, a formidable tabulation of tolerances to be observed. From the writer's own experience as inspector and supervisor of inspection on construction work, he found that skilled tradesmen are almost without exception capable and efficient men who take pride in doing a piece of work right, and that contractors are not niggardly in allowing them time to exploit their skill.

An able inspector can usually obtain better results by explaining the importance of the work, what method of checking will be used, what measurements will be taken, and above all, by providing reference points that will be used in common by contractors' men and the inspector, rather than by stipulating tolerances that will be allowed. If there is as much honor and mutual respect among engineers and contractors as is proverbially supposed to exist amongst thieves, it should be sufficient to specify that "the work shall be done in accordance with good engineering practice," in order to assure the necessary accuracy. Let's leave the matter of general tolerances to the judgment, ingenuity, and even imagination of the field engineers.

The phrase "as directed by the engineer," must not be used indiscriminately, but there is no good reason why it should be outlawed. Surely the color of a given paint may be "as directed by the engineer," and the water content of a concrete mix may be increased or decreased to give a desired slump, or the aggregate proportions may be changed to correct a harsh or an oversanded mix, all, "as directed by the engineer." To cite a different type of legitimate usage, it may be desirable to make provision for placing additional fill in a portion of an embankment after the rate of settlement of the completed contract fill has been observed; under such conditions, the specifications may properly require that the contractor place additional fill "as directed by the engineer," but should also state how the additional fill will be paid for, as for example, "and payment therefor will be made according to the terms of a change order which will be negotiated under the provisions of Article No. —, of the contract."

All of us can undoubtedly recall some instance when a comparatively intricate and important item of work was executed in exemplary fashion without either the inspector or the contractor having read the specifications. The explanation is simple; both parties by virtue of previous training and experience knew the intent of the specifications without reading them. When disagreement does arise, the parties involved should attempt to learn the intent of the specifications instead of resorting to fine-toothed-comb tactics, searching through the specifications for the inclusion or omission of a few relatively insignificant words that each will contend lends credence to his side of the argument. Specifications should be read and studied in their entirety. Too many persons merely single out an isolated paragraph or phrase pertaining to the specific problem at hand and base their interpretation on a trifling morsel of the complete thought.

Broad viewpoint necessary

The specifications writer is constantly keeping his ear to the ground listening for a trend in the interpretation of specifications by contractors and engineers that will permit him to use concise engineering and contracting language in the specifications. Though they may not realize it, engineers and contractors are getting what they demand. When they demonstrate by their manner of interpreting specifications that they do not need "red tape" or "verbosity," the specifications writers will be alert to omit this material. When the ethics and practices of interpretations become standardized, "dizzy tailspin" payment clauses will disappear from specifications and they will cease to be a "lawyer's delight." Just as our common law developed over a period of centuries by accumulation, sifting, and averaging of man's concept of justice, the ideal specifications are not going to be a spontaneous contribution by one brilliant mind, but will be approached only through a gradual process of perfecting, as there is developed a judicious code of practice for their interpretation.

A new era for specifications

We are emerging from a period of hectic engineering construction when both plans and specifications have been hurriedly prepared and just as hurriedly disregarded as the necessity for short-cuts and substitutes has been unavoidable. Time has been of paramount importance; cost and quality of material and workmanship, secondary. We hope soon to embark on a program of construction when economy in cost and reasonable engineering refinement will again be the order of the day. This period would indeed, be an opportune time to bring out a better brand of specifications. As soon as the engineering profession and the contracting world are ready for better specifications, the specifications writers will produce them.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

eneral Term for Euler Formula

In the general field of column anal- is Euler's formula plays a most portant part, and the formulas rep- sented by the family of curves $= S_u - Kx^n$ covers a broad field of alysis. In order to simplify the de- rmination of the value of K for dif- rent values of n, S_u, and E, a gen- alized solution may be well worth- hile.

The standard form for Euler's lumn formula is:

$$\frac{P}{A} = \frac{\pi^2 E}{\left(\frac{1}{r}\right)^2}$$

we let

$= y, \frac{1}{r} = x$ and $\pi^2 E = a$, we have $y = \frac{a}{x^2}$

here is a "family" of column form- as of the form:

$$\frac{P}{A} = S_u - K\left(\frac{1}{r}\right)^n \text{ or } y = S_u - Kx^n$$

Since there is a different value for for every value of n, the writer be- eves that a general value for K may helpful.

This general value for K is

$$\frac{2}{na^{\frac{n}{2}}}\left[\frac{S_u}{1+\frac{2}{n}}\right]^{\frac{n}{2}+1}$$

he complete derivation of the expres- on for K is rather involved and ngthy, so it is not included.

It may be of interest to note that e ordinate of the point of tangency is

$$\frac{S_u}{1+\frac{2}{n}}$$

—LOUIS O'SHAUGHNESSY, *Virginia olytechnic Institute, Blacksburg, Va.*

ow Fence Painting Equipment

The West Virginia State Road Com- ssion expects extensive man-hour vings from equipment built to re- ce the work of painting snow fence. an accompanying photograph ows, the equipment consists of the lowing:

A 1½-ton, flat-bottom truck on which is mounted directly behind the cab a small derrick or crane operated by a winch driven by a power take-off from the drive shaft of the truck. Mounted on the back of the truck is a metal container that is larger in diameter than the average standard roll of snow fence and deeper by about 2 ft. than the height of the roll. The cylindrical tank serves as a receptacle for the liquid preservative. Erected beside the tank is a demountable platform that drains into the tank.

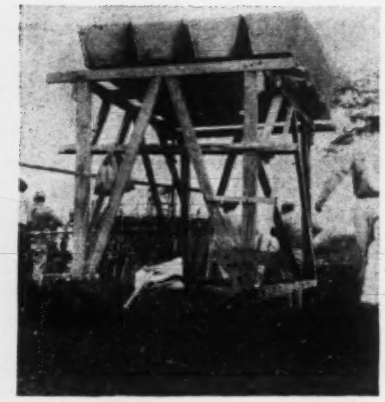
When the equipment is used the derrick swings around, picks up a roll of fence, hoists it up and sets it down into the container, where it is fully immersed in the liquid. After the roll has been in the liquid for a couple of minutes, it is lifted out and set on the platform to allow the excess liquid to drain back into the tank. Finally, the roll of fencing is lowered to the ground again.

Mounted also on the flat bottom between the derrick and the large tank is a small tank containing the same liquid preservative. A small power driven pump together with a hose and spraying apparatus is attached to the tank. This unit is used to spray paint on small sections of fence or other items.

No data is yet available as to the actual cost saving in following this method of painting snow fence, but E. L. Worthington, state maintenance engineer, reports that sufficient fencing has been painted to prove that the method is economical.

Sylvester Mazella, state equipment inspector, designed and supervised the building of the painting equipment.

At little expense a truck was equipped with lifting equipment and a large steel drum to facilitate the painting of snow fence.



CAMERA MEMORANDUM

When metal tanks for elevated water storage for concrete work on the Inter-American Highway in Nicaragua could not be obtained, workers of the Frederick Snare Corp. built the four wood tanks above. Of 1-in. lumber sawn by native labor at a nearby mill and providing a total of about 200 gal., the tanks proved very satisfactory.

Stresses in Guy Cables Subjected to Initial Tension

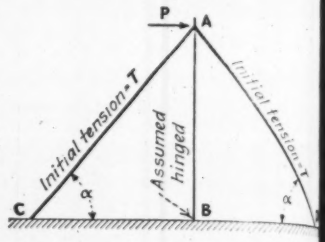
What constitutes the total stress in a cable stressed to induce initial tension and then subjected to additional tension from external loading is a troublesome problem sometimes encountered. For example, it arises in connection with guyed steel stacks, guyed towers and other structures which are not self-supporting under wind load.

Some engineers assume that guy cables subject to both initial tension and tension due to external load are stressed to an intensity equal to the sum of the two stresses. However, it can be shown that the total stress in any such guy cable is equal to the initial tension in the cable plus an additional stress from external load equal to that caused by half the external load when such external load is less than the sum of the horizontal components of the initial tensile stresses in the guys. In addition, when the external load is equal to or greater than the sum of the horizontal components of the initial tensile stresses in the guys then the maximum stress in one guy is equal to but never greater than the stress caused by the external load only.

In the accompanying sketch let AB represent a stack or tower stayed by guys AC and AD, the initial tension in each cable equal T, and let P represent wind load concentration at the point of attachment of the cables to the tower.

Also, let it be assumed that the value of P is less than $2T \cos \alpha$. Since AC and AD are each subject to an initial tensile stress T, the initial deformation of cable AC will be equal to initial deformation of cable AD. For the direction of the force P shown in the figure, the tension in AC will be increased; that is, cable AC will be lengthened. As AC is lengthened by the applied force P, the cable AD will be correspondingly shortened. This action means that as the tensile stress in AC increases the initial tension in AD will decrease by an equal amount to establish equilibrium about the joint. In order words, Load P brings about an increase in the stress in AC and a corresponding decrease in the stress in the cable designated AD in the sketch.

When P is less than $2T \cos \alpha$ the tension in AC will equal $T + P/2 \sec \alpha$; and the tension in AD will equal $T - P/2 \sec \alpha$. When P is equal to $2T \cos \alpha$, the stress in AC will equ $T + T \cos \alpha \sec \alpha = 2T$, which is the same as saying that the total stress in AC is the stress caused by the force P only, irrespective of the initial tension in the cable. The stress in AD will, of course, be equal to $T - T \cos \alpha \sec \alpha = 0$.



Sketch used to evaluate stresses in guy cables.

It follows that for all values of P equal to or greater than $2T \cos \alpha$ the total stress in cable AC will be equal to $P \sec \alpha$; that is, the total stress in AC will be that caused by the force P only, irrespective of the intial tension while the value of the stress in cable AD will become equal to zero.—E. VINER, *Structural Engineer, U. S. Engineers, Providence, R. I.*

Irving Subway Grating

SUBWAY GRATING REDUCES GRADE CROSSING MAINTENANCE

Subway grating is being used by the Erie R. R. to reduce grade crossing maintenance. The above photograph shows how the grating was installed at Carrollton, N. Y., at the bottom of a sloping highway just before it reaches the crossing. Dirt, ice, stones and other debris moving down the slope drops through the grating into a culvert below. The grating is removable, which permits the culvert to be cleaned quickly if this proves necessary. The Erie has made similar installations at Jamestown, N. Y., and Union City, Pa.

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1. Keep adding approved water at regular intervals. Most local water is safe. Ask us if yours is safe.
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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

AIRPORT, ROCK COUNTY, WIS.

OWNER: Civil Aeronautics Administration, Third Region, Chicago, Ill.; A. W. Carlson, engineer.

PROJECT: Grading, drainage, and paving at Rock County Airport, Janesville, Wis. Grading and drainage (Part II, Schedule I) involves clearing and grubbing, removal of fence, clean-up of building sites, 604,200 c.y. of grading, installation of storm sewers, fertilizing, seeding, sodding, and 3-in. underground ducts encased in concrete. Paving (Part I), included minor grading and drainage structures, painting runway numbers, fertilizing, seeding and fencing in addition to actual paving work. Alternates were allowed for paving as follows: (Schedule I) 7-in. non-reinforced Class A concrete pavement; (Schedule II) bituminous paving, including waterbound macadam base course and special bituminous surfacing for apron and ends of runways and taxiways; (Schedule III) bituminous paving for runways and taxiways exclusive of apron and ends of runways and taxiways, with waterbound macadam base course, and concrete paving of apron and ends or runways and taxiways; (Schedule IV) bituminous pavement with emulsified asphalt base course; and (Schedule V) bituminous pavement for runways and taxiways, with emulsified asphalt base course, and concrete paving of apron and ends of runways and taxiways. Award made on basis of Schedule II, and tabulations shown below for paving are for Schedules I and II.

CONDITIONS: Contractor to furnish all materials and complete work on Part II in 120 calendar days, and on Part I in 120 days. Rail and highway transportation facilities available. Wage rates are skilled labor, $1.25 to $1.75 per hour; semi-skilled, 90c. to $1.25; and common, 80c.

BIDS: Fourteen bids were received on Sept. 28, 1943 for the grading and drainage contract, ranging from the contract low of $158,167 to $325,825. Thirty-seven bids were received Nov. 8, 1943 on all paving alternates (six on Schedule II) ranging from the contract low of $482,774 to $831,323.

Part II—Schedule I, Grading and Drainage

LIST OF BIDDERS: (Bids Received Sept. 28, 1943)

1. Raemisch & Madden, Middleton, Wis. (contract) $158,167
2. Johnson-Greene Co., Ann Arbor, Mich 171,369
3. Nelson, Mullen & Nelson, Inc., Minneapolis, Minn 186,941
4. Bonness, Inc., & Bloomer Co., Milwaukee, Wis. 190,074
5. A.G.T. Associates, Eau Claire, Wis 203,775
6. Central Engr'g. Co., Davenport, Iowa 206,163
7. P. W. Ryan Sons, Janesville, Wis 218.893
8. T. M. White Co., Chicago, Ill 219.535
9. A. B. Lynch Co., Milwaukee, Wis 226.202
10. Thomas McQueen Co., Forest Park, Ill 238.042
11. S. J. Groves & Sons Co., Minneapolis, Minn 283.038
12. Burch Constr. Co., Madison, Wis 287,980
13. Frank Mashuda Co., Milwaukee, Wis 306,955
14. Oliver, Engelhart & McFadden, Madison, Wis 325,825

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clear. and grub., inside grading limits	Lump Sum	$500.00	$1,500.00	$750.00
2 Clear. and grub, outside grading limits	1,500 in dia.	.25	.50	.60
3. Clearing trees outside grading limits	500 in dia.	.15	.40	.40
4. Remove fence, outside grad. limits.	500 rods	.20	.60	.40
5. Clean up building sides	Lump Sum	300.00	400.00	500.00
6. Grading	604,200 c. y.	.21	.22	.245
7. 15-in. storm sewer, extr. str., std. str., or triple strength	253 l. f.	2.50	2.75	2.70
8. 15-in. storm sewer, extr. str. or triple strength, concrete	575 l. f.	3.00	2.50	
9. 18-in. storm sewer, extr. str., std. str. or triple strength	430 l. f.	4.00	3.40	
10. 24-in. storm sew. (C76) ext. str.	212 l. f.	5.00	5.00	
11. Concrete for sewer inlets, headwalls	24 c. y.	40.00	40.00	
12. Drywell structures, in place	34 ea.	135.00	100.00	
13. Modify existing drywells	19 ea.	30.00	20.00	
14. Reinforcing steel, drainage struct.	1,740 lb.	.10	.10	
15. 30-in. grate bar units	458 ea.	1.50	2.50	
16. Fill existing drywells	9 ea.	15.00	10.00	
17. Smooth field areas outside grading limits	150 ac.	10.00	15.00	
18. Fertilising	480 ac.	7.50	10.00	
19. Seed field with oats	480 ac.	5.00	7.00	
20. Seed field with grass seed mixture	480 ac.	8.50	8.00	
21. Sodding	570 s. y.	.50	.50	
22. 3-in. underground ducts, encased in concrete, one-duct bank	4,048 l. f.	.90	1.50	
23. As above, two-duct bank	1,352 l. f.	1.40	2.50	
24. As above, four-duct bank	56 l. f.	2.00	4.00	
25. As above, six-duct bank	56 l. f.	3.00	5.00	

Part I—Schedule II, Paving

LIST OF BIDDERS: (Bids Opened Nov. 8, 1943) Award made on this schedule.

1. Rock Road Constr. Co., Chicago, Ill. (contract) $482,7
2. J. Rasmussen & Sons, Oshkosh, Wis. 521,7
3. Payne & Dolan, Milwaukee, Wis 548,6
4. Fielding Shepley, Inc., St. Paul, Minn 572,8
5. Barber Equip. Co., Chicago, Ill 630,3
6. H. G. Goelitz, Chicago, Ill 831,3

Item	Quan.	Unit Prices (1)	(2)	(3)*
1. Misc. grading, as ordered (max. haul 1,500 ft.)	500 c. y.	$0.60	$0.40	$0.0
2. Installing french drains	10,000 c. y.	1.50	1.75	3.
3. Duct markers in place	104 ea.	2.00	1.00	1.0
4. Paint runway numbers (incl. paint)	Lump Sum	300.00	400.00	1,500.0
5. Fertilising	35 ac.	10.00	10.00	20.0
6. Seeding (oats)	35 ac.	10.00	8.00	20.0
7. Seeding (grass seed mixture)	35 ac.	10.00	12.00	20.0
8. Fencing (Class C, woven and barbed wire, wood posts; two 12-ft. gates)	1,365 rod	3.00	3.00	4.0
9. 8-in. stabilized gravel sub-base course	339,508 s. y.	.40	.465	.3
10. 4-in. waterbound macadam base course	337,952 s. y.	.44	.435	.5
11. Prime coat, applied	135,200 gal.	.09	.090	.0
12. 2-in. central plant hot-mix bitu. surf. crse. (runways and taxiways)	31,200 ton	2.90	2.93	1.9
13. Spec. bitum. surf. for apron and ends of runways and taxiways	6,200 ton	3.25	3.52	4.0
14. Asphalt cement for Items 12 and 13	506,000 gal.	.075	.097	.0
15. AC tack coat on first bitum. surf. crse. runway and taxiway ends	5,900 gal.	.10	.10	.1
16. RC-2 for seal coat, applied	84,100 gal.	.10	.099	.0
17. Seal coat aggregate, in place	3,365 gal.	2.25	2.75	1.5

* *No unit bid prices available for third low bidder: Fielding Shepley, Inc., (fourth low price shown.*

Part I—Schedule I, Paving (Concrete)

LIST OF BIDDERS: (No Award on This Basis)

1. Arcole Midwest Corp., Chicago, Ill. $509,1
2. Joseph D. Bonness, Milwaukee, Wis. 535,6
3. A. G. T. Associates, Racine, Wis. 562,6
4. I. D. Lain, Bloomington, Ill. 569,7
5. Fielding Shepley, Inc., St. Paul, Minn 574,1

Item	Quan.	Unit Prices (1)	(5)*	(2)
1. Misc. grading, as ordered (max. haul 1,500 ft.)	500 c. y.	$1.00	$0.60	
2. French drain installation	10,000 c. y.	.60	.75	
3. Duct markers in place (ducts installed under previous contract)	104 ea.	1.00	1.50	
4. Runways numbers painted, including furnishing paint	Lump Sum	1,100.00	1,500.00	
5. Fertilising	35 ac.	14.00	20.00	
6. Seeding, oats	35 ac.	6.50	50.00	
N. Seeding, specified grass seed mixture	35 ac.	12.50	50.00	
8. Fencing, Class C (woven and barbed wire, wood posts), 2 12-ft. gates	1,365 rods	4.25	4.00	
9. 7-in. non-reinforced Class A concrete pavement	336,396 s. y.	1.47	1.65	

* *No unit prices shown for second, third and fourth bidders on concrete paving. Fielding Shepley, Inc., was fifth low bidder.*

The convoy leaves at midnite

In busy sea-ports all over the world Industrial Brownhoist cranes are speeding loading operations, saving thousands of man-hours in the handling of vital war materials. And in steel mills, coal yards, railroads, chemical plants and other war plants throughout the country I. B. cranes are also working night and day—seldom, if ever, requiring time out for repairs. They get more work out of a gallon of gas or fuel oil than you'd think possible. They increase the operator's efficiency because their monitor-type cabs provide 360° visibility, better ventilation and less noise. Write us for complete facts about these sturdy, time-saving, money-saving cranes. Industrial Brownhoist Corp., Bay City, Michigan. District offices: New York, Philadelphia, Pittsburgh, Cleveland and Chicago.

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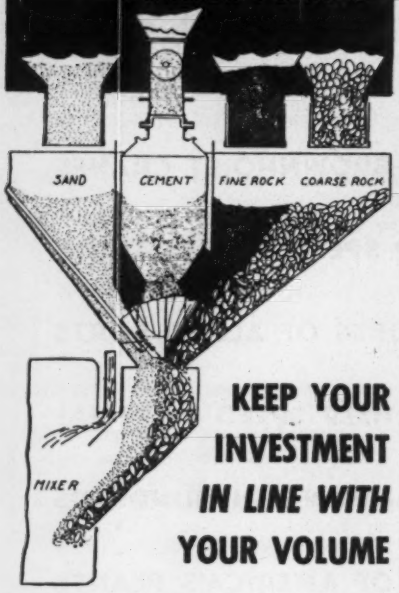
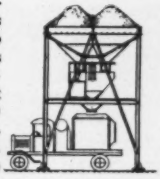
JOHNSON
Step-by-Step
TRUCK MIXER PLANTS

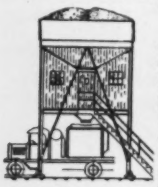


KEEP YOUR INVESTMENT *IN LINE WITH* YOUR VOLUME

Here's how to plan a central mix plant that holds your initial investment to a minimum, but makes expansion easy and economical. Diagrams at left and right show how a 30 yard Johnson Step-by-Step Bin can be progressively enlarged to 60 yards and 120 yards . . . without discarding a dollars worth of the original plant.



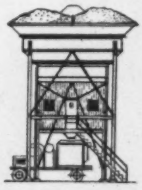
30-Yard 2 Material Bin



60-Yard 3 or 4 Material Bin

The Johnson Concentric Aggregate-Cement Batcher (see diagrams above) gives your plant the important advantage of (1) Pre-mixing, (2) Pre-shrinkage, (3) Faster Discharging, (4) Elimination of Cement Dust and Mixer Gumming, (5) Centralized Control. Patented design assures a full capacity mixer charge by accurate intermingling of aggregates with the cement when discharged. Many other exclusive capacity-increasing, time-saving, profit-boosting features.

When planning a mixing plant, it will pay you to get all the facts on Johnson *Step-by-Step* Plants. Write us for details.



120-Yard Bin

The C. S. Johnson Company
Champaign, Illinois

NEW AIDS TO THE CONSTRUCTOR

Combustion Control Equipment

Applicable to boilers fired with coal, oil or gas, a new Type P combustion control system continuously proportions fuel and air to steam demand, and controls furnace pressure. A simple electrical balance regulates fuel-feed and draft. If full automatic control is not desired, the operator can move any of the drive units from push button stations. The drive units, which operate independently, allow the controllers to be serviced without interrupting boiler operation.

Except for drive units, all this combustion control equipment can be shipped on an easy-to-install panel. If preferred, equipment can be mounted on a complete boiler panel. Drive units are connected to the panels by simple conduits.—*Leeds & Northrup Co., 4934 Stanton Ave., Philadelphia 44, Pa.*

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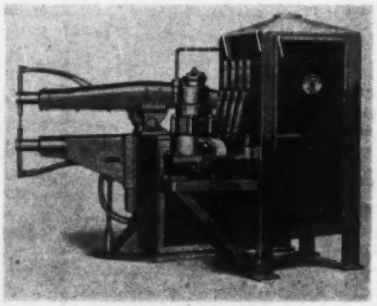
Storage Battery Welders

Storage batteries are used as the source of welding current in a recently developed direct-current resistance welder. The use of batteries does not involve radical re-design of the welders,



but it does make possible resistance welding in locations where other forms of power are not available.

Other advantages claimed for the use of storage batteries for welding include elimination of inductive losses in the welding loop, and of reactance losses between power supply and electrodes; less critical adjustments to get consistently good welds; greater operating and maintenance simplicity; a higher degree of safety.—*Progressive Welder Co., 3050 East Outer Drive, Detroit 12, Mich.*

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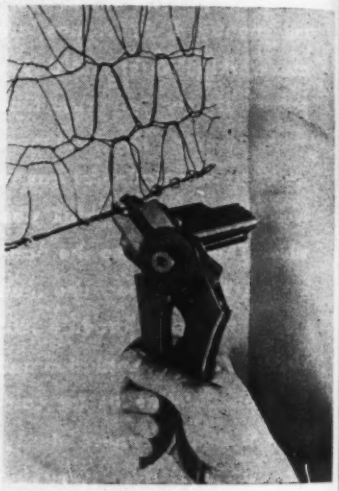
Stapling Plier

Said to apply 60 to 70 rings with one loading, a new magazine-fed stapling plier, for postwar civilian use, is designed for rapid, one-hand loading. Narrow jaws enable it to get into small spaces.



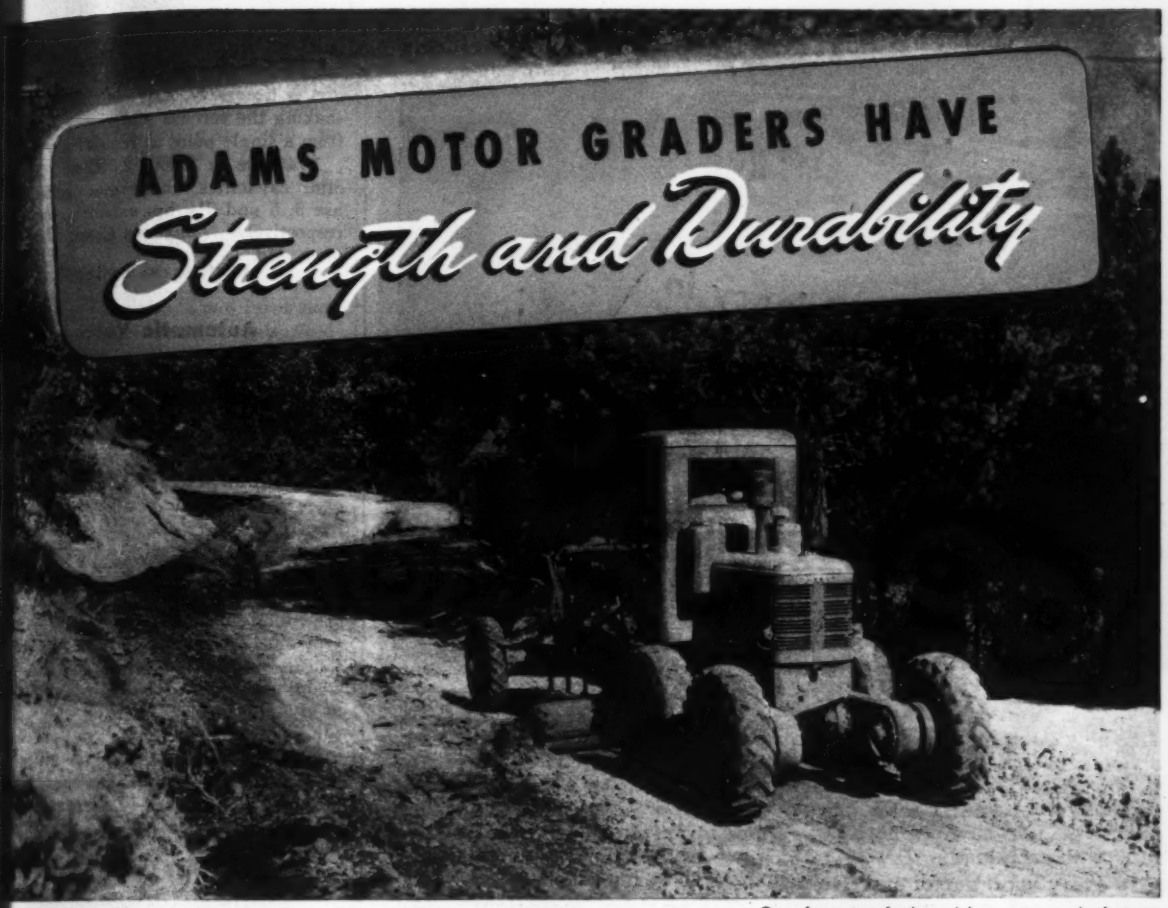
The plier weighs less than 2 lb. It has a ¼-in. ring diameter and ring overlap, and is No. 16 wire size.—*Bostitch, 117 Division St., East Greenwich, R. I.*

. . .

Unit Dust Collector

Based on 35 years' experience in solving dust-control problems, a new unit dust collector is of rugged construction, and is self-contained, occupying minimum floor space. This Type CK dust collector consists of a preliminary centrifugal section and a secondary cloth screen section.

The collector is flexible in arrange-



One of a series of ads on Adams motor grader features

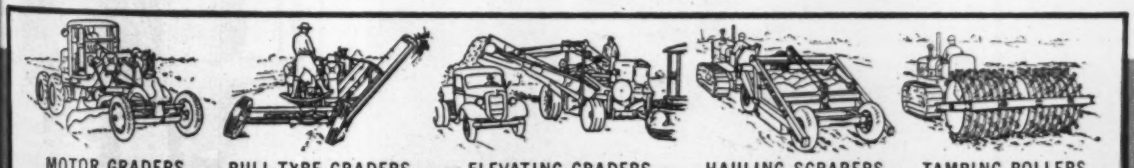
CARVING ROADS out of mountain sides—punching shale out of banks—making heavy ditch cuts—scarifying hard surface material—bucking heavy snow drifts—these are everyday operations for many Adams motor graders. It's work that demands strength to withstand heavy shocks and stresses. It requires durability if the machines are to stand up under punishment day after day.

Adams motor graders have that strength and durability. They get it, not through sheer bulk and weight of materials, but through painstaking engineering—engineering which is focused always on obtaining strength without excessive weight, because unnecessary weight is a liability in any machine.

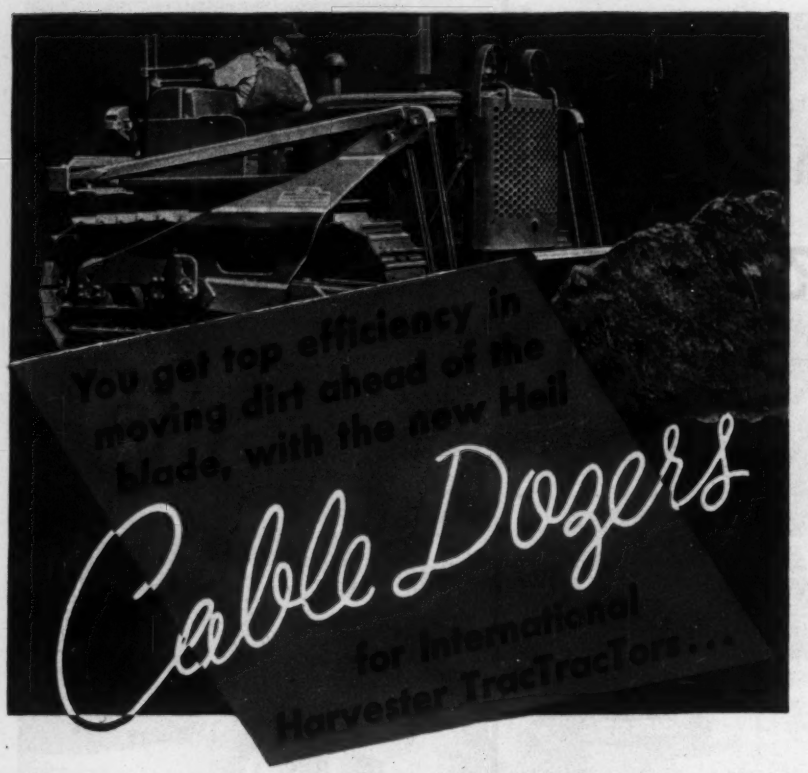
Their long life, their ease and economy of operation, their wide adaptability to all kinds of work will make Adams motor graders your best buy when again you can purchase new machines. In the meantime, use the services of your local Adams dealer to keep your present equipment rolling.

J. D. ADAMS COMPANY · INDIANAPOLIS, IND.

Granted a second Army-Navy Production Award for continued proficiency in the production of grading machinery for our armed forces



ADAMS ☆ ROAD-BUILDING AND ☆ EARTH-MOVING EQUIPMENT


You get top efficiency in moving dirt ahead of the blade, with the new Heil
Cable Dozers
for International Harvester TracTracTors...

This new equipment is designed to give perfect balance with International TracTracTors, so that the full power of your tractor drives on the blade—moving more "pay dirt" with each load.

In every way, tractor and equipment work together in a perfectly matched team. The simplified mounting does not obstruct the operator's view, but gives him full, free vision ahead. Note the convenience of the controls which are adjustable to his reach.

The machine "feels right"—performs smoothly, gives fast, positive action under the toughest conditions. Send for bulletin describing many other features which assure you of outstanding performance at lower cost. R-23

ment, and discharges air free of dust and moisture. The screen-cleaning mechanism is motor driven. No attention is necessary, it is claimed, beyond shaking the screens and removing dust from a single point at regular intervals.

Available in 1,000, 2,000 and 3,000 cfm. capacities, these unit collectors use 3, 5 and 7½ hp. exhauster motors respectively.—*Pangborn Corp., Hagerstown, Md.*

. . .

Automatic Valve

Promising to answer many fluid transport problems, the new "Du-Al" instantaneous automatic valve has a simple, dependable, foolproof action, according to the manufacturer's announcement. Valve operation depends on the balance of pressure upstream and downstream from the valve; when the downstream pressure fails, the valve instantly closes automatically.

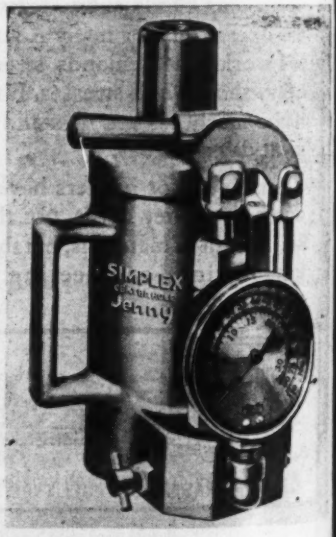
Because no electrical equipment is needed for the "Du-Al" valve, it is highly economical to install, operate and maintain, it is claimed. And because no outside power source is used, the valve can safely be used in sections where gas vapors are present.

This new valve, in sizes for all pressures and temperatures, has been tested in actual operation.—*Ludeman Valve Co., 420 Lexington Ave., New York 17, N. Y.*

. . .

Hydraulic Puller

Speed in production, maintenance and repair jobs is said to be the leading characteristic of the new Simplex Jenny



center hole hydraulic puller. This self-contained unit pulls, pushes or lifts, and operates vertically or horizontally, without side thrust or friction.

Five models are available, of 30 to

tons capacity. Three models have cle pumps, and two have high and speed pumps which operate separely, alternately, or together. The is built of heat-treated alloy steels, each is tested before shipment for percent overload.—*Templeton, Kenly Co., 1020 South Central Ave., Chiago, Ill.*

• • •

Roofing Insulation

Known as Foamglas, a new insulation terial is made from cullet-pulverized ss to which a small proportion of ely divided carbon is added. Certain des react with the carbon in the

lten glass to make carbon monoxide d dioxide gases, which are trapped hin the glass to form tiny, sealed air mbers. These cells number five milin a cubic foot, making the weight the material about 10.5 lb. per cu. ft. Cellular rather than porous, Foamglas impervious to water, vapors, and acid nospheres or solutions, it is claimed. her advantageous properties are high pressive strength, rigidity, high reance to fire, ease of installation, low t, and durability.

Standard size of the slabs or blocks is 18 in., in 2, 3, 4, 4½ and 6 in. thickses.—*Pittsburgh Corning Corp., tsburgh, Pa.*

• • •

Magnetic Voltage Selector

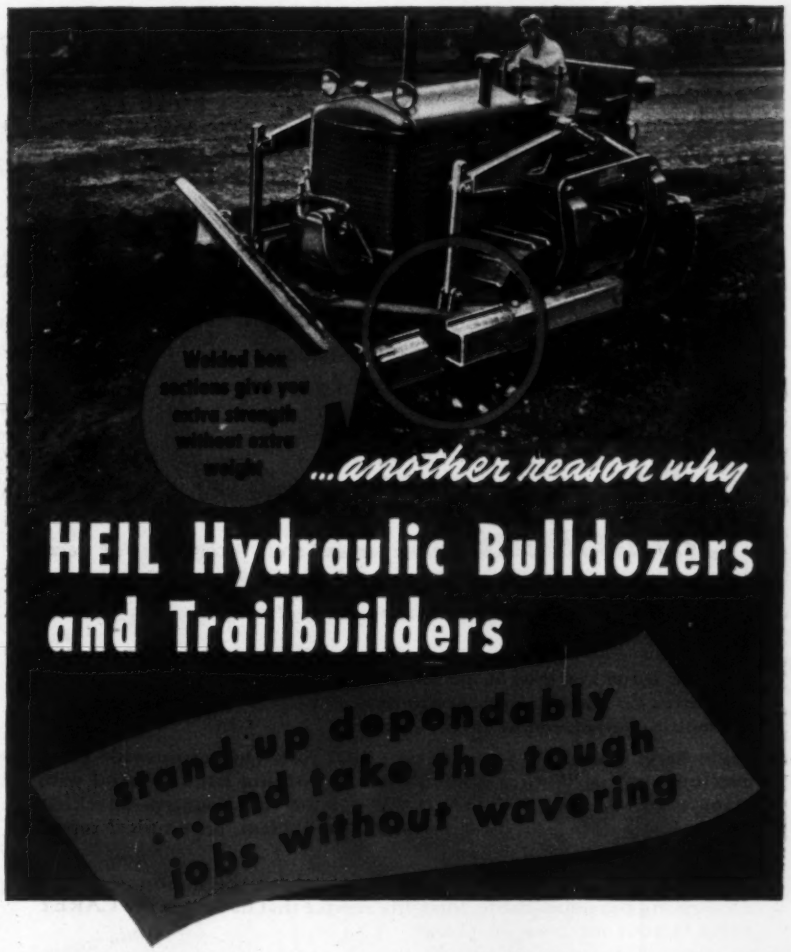
Showing many features for precision efficiency, a new magnetic voltage ector embodies automatic main magic contacts, and automatic main itch contacts. These contacts are proed for nine positions, at 2½ volt ervals, from 2 to 40 volts.

The selector unit is conveniently eled for ready accessibility, and mpactly cased.—*Zenith Electric Co., West Walton St., Chicago 10, Ill.*

• • •

Six-Way Air Filter

Great flexibility due to six outlets in manifold, and a new self-dumping to automatically empty water, are standing features of a new com-


Welded box sections give you extra strength without extra weight
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Heil engineers and fabricators have pioneered the modern practice of replacing heavy members with welded box sections that are lighter, stronger, and easy to repair in the field without costly delays. The advanced design of Heil equipment assures you of more speed . . . greater flexibility . . . and ability to push through when the going is tough. Because they're tailormade to Cletrac Tractors, you get full visibility for safe, efficient handling.

The Trailbuilder blade is easily angled to right or left for side-casting new cuts. Bulldozer blade takes rocks and stumps without changing pace.

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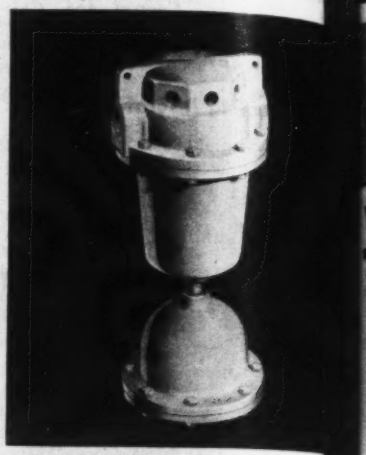
Heat Insulation saves fuel in power plants.

Built-Up Roofs provide weather protection.

Asbestos Pipeline Felt protects "Big Inch" oil line against corrosion.

pressed air line filter, according to the manufacturer's announcement. The outlets are ⅜ in., to accommodate snap-on hose connections. The water trap automatically disposes of water filtered out of the lines, with a closed float that



guarantees positive opening and closing of the discharge valve. Interior parts are heavily plated to reduce rust.

The manufacturer also claims that this CAA filter prevents dust, rust, scale, oil and water from entering air tools, whose life and efficiency are thus increased.—*Filters, Inc., P. O. Box 471, Glendale, Calif.*

• • •

Strap Wrench

Developed for better handling and protection of polished nickel and chrome pipe and tubing, the new "Ridgid" strap wrench is of strong construction. It is made with a strong I-beam handle and solid head in one piece, with a hole in one end to hang it up. A special webbing strap, said to be of great strength, may be quickly removed for replacement by pushing out the pin held by spring clips.

This strap wrench is made in two sizes: No. 2, capacity ⅛ in. to 2 in., 17-in. strap; No. 5, 1 in. to 5 in., 30-in. strap.—*The Ridge Tool Co., Elyria, Ohio.*

• • •

Chaser Grinding Fixture

Easily mounted on the table of any conventional tool and cutter grinding machine, and adjustable for any throat or rake angle desired, a new chaser grinding fixture will hold all sizes and types of dies or chasers. The fixture measures 5½x5½x9 in., unboxed; its net weight is 25 lb. and shipping weight 35 lb.

Among the advantages claimed for this device are accurate grinding which saves replacement costs, and elimina-

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has all of these features

1. Multi-speed regulator which automatically adjusts the engine speed to the use of air and practically eliminates wasteful idling... reduces average working speed of compressor and engine, resulting in more efficient operation and longer life ...and with pressure characteristics that will get more work out of air tools. (On MOBIL-AIR compressors, this regulator is called the "Drill-More" regulator.)

2. Convertible engine... quickly changed from operation on one fuel to another (gasoline, oil, or natural gas) by substitution of external fuel accessories only.

3. If a gasoline engine, the most economical type... which will make substantial savings even with regular gasoline and at all loads.
Or if an oil engine, a low-compression type that is easily started and easily maintained.

4. A modern two-stage air-cooled compressor with Channel Valves.

5. Unified assembly of compressor and engine ...maintaining permanent alignment.

6. Light weight...but strong, sturdy, and tough.

7. Reasonable over-all dimensions.

8. Sturdy, easily operated and easily maintained clutch.

9. Electric cranking (for oil as well as gasoline engine) with commercial 6- or 12-volt equipment.

10. All operating controls and gauges centrally located.

11. Stream-lined design... for strength and durability.

12. Low, easily filled fuel tank.

13. Spring mounting and automotive steering if 210 cfm size or larger, 2-wheel trailer for all smaller sizes.

14. A fine, durable finish.

15. Proven design and performance.

These features are built into MOBIL-AIR compressors... 5 sizes 105 to 500 cfm. These are the portables that decreased gasoline consumption as much as 40% compared to best previous models...and that established new records of endurance, reliability and low maintenance. Insist that your next portable is a MOBIL-AIR.

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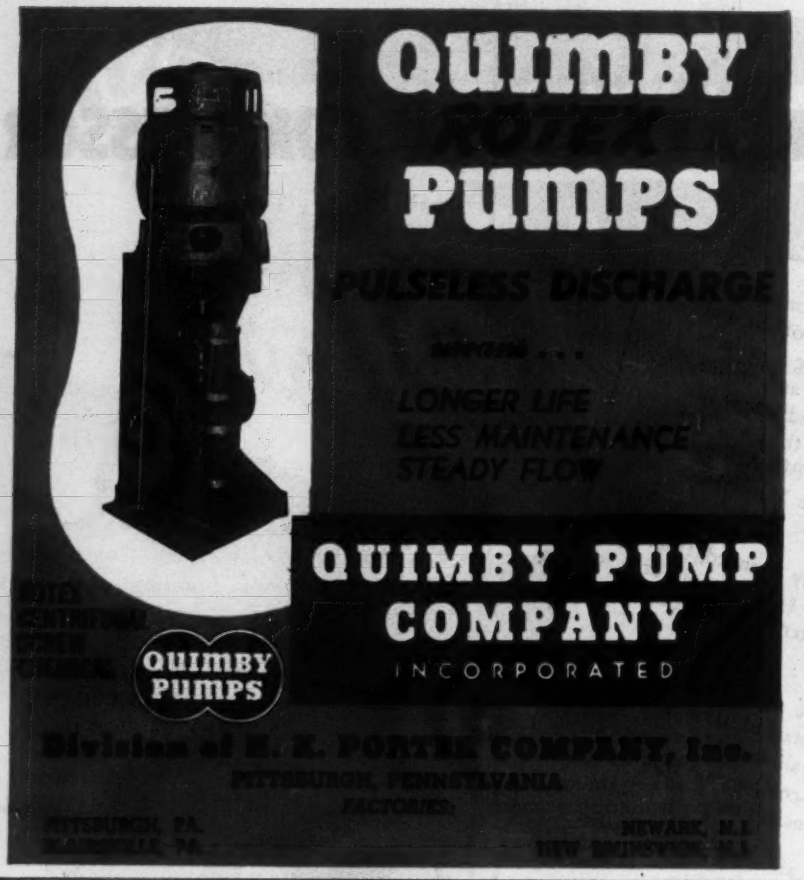

There is no job too big and no job too small for Brooks LOAD LUGGER and its "litter of bodies."

Speeding up production on the home front by more efficient movement of materials and supplies will go a long way toward *knocking the Axis off its bearings* and hastening the day of victory.

One Load Lugger unit with 5 to 10 dump buckets will replace a whole fleet of ordinary trucks . . . increasing daily haulage, saving time and manpower.

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tion of wear and tear on threading machines.—*The Oster Mfg. Co., 2057 East 61st St., Cleveland 3, Ohio.*

• • •

Truck Tire

Designed primarily to lessen operating heat, the new Speedliner Silvertown truck tire is also said to reduce the dangers of sidewall cracking. This tire, available in size 7.50-20 eight ply or

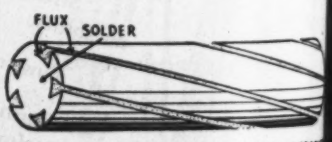
larger, has reduced tread thickness at the shoulders and additional ventilating grooves in the shoulder blocks.

The tire's sidewall is now thicker at the base of the grooves between the shoulder blocks, and the ornamental rib on the sidewall is of more shallow construction to provide better stress distribution.—*The B. F. Goodrich Co., Akron, Ohio.*

• • •

Fluxed Wire Solder

With flux in longitudinal grooves on the surface, a new type of fluxed wire solder is said to guarantee an unbroken flow of flux. This new material, called "Fluxrite," liquefies and flows into the



NEW TYPE OF WIRE SOLDER WITH FLUX IN GROO

work before the solder melts, it is claimed, thus insuring thorough fluxing and strong solder joints.

This product comes in the same diameters as regular cored solder, and is available with red stripe or green stripe flux.—*National Lead Co., 111 Broadway, New York, N. Y.*

NEWS OF THE WEEK

(Continued from p. 75)

Use of outside firms approved in New York

Cities and towns in New York State y engage private firms to do engineer- and architectural work for them, ording to a finding of the state Court Appeals, the highest court in the te, given on March 10. The court's ision related to two similar cases ught to it from lower courts. One s an appeal from a decision of Justice cora of the state Supreme Court in an nction suit brought by the Civil vice Technical Guild against Mayor Guardia and other officials of New k City to restrain them from employ- outside engineering firms for work the city's postwar program (*ENR* 15, 1943, Vol. p. 124), and the r was in a like suit brought to keep Board of Education of New York from engaging outside architects school design work.

ustice Pecora, in denying the appli- on for injunction against the city cials said: "I conclude that nothing tained in the constitution of the State New York or in provisions of the Civil vice Law prohibit the city of New k from awarding contracts for archi- ural and engineering services to pri- concerns in connection with the t-war planning program. This court ther holds that the action of the city cked herein is in line with sound lic policy and represents a wise exer- of discretion." (*ENR* Nov. 4, 1943, p. 662).

his finding was upheld by the Court Appeals.

he engineers and architects were resented in this action by Eidlitz, nch and Sullivan, attorneys, New k.

. . .

Engineers at work on Portland sewer job

ortland, Ore., has employed the en- ering firms of Stevens & Koon and W. Cunningham and Associates to ointly in the preparation of detailed s and specifications for construction n intercepting sewer and sewage ment works. The joint engineers assumed the name "Engineers, land Sewerage Project."

his is the first of the major projects mmended for Portland by Robert s, New York City park commis- r, in his recent report on a postwar

He made water climb steps...

An engineering triumph in irrigation and flood control! That's what Archimedes gave the people of Egypt 200 years before Christ. This Greek pioneer in mechanics and hydrostatics invented the "Archimedean Screw" to raise the waters of the Nile. Water climbs in the spiral tube until it gushes out of the top.

Draftsmen echo Archimedes' "Eureka!" when they discover Eldorado pencils. For they find pencils whose leads retain their points under pressure and "give-off" smooth, even lines that exclude light. They discover uniformity—each degree is exactly as it is stamped. They discover that here in America the world's most useful tool for drawing has, in *Typhonite* Eldorado, reached a perfection that makes draftsmen take pride in their work and gives joy to the heart of the blueprinter.

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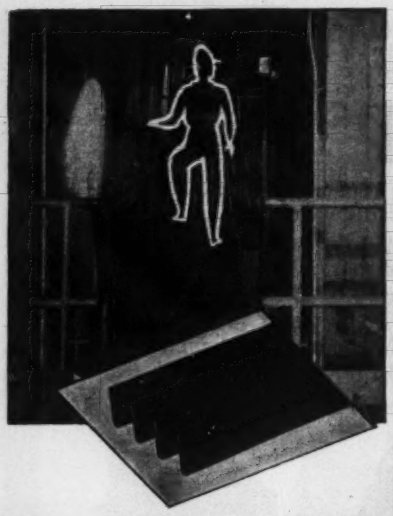

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Write for copy of well-illustrated, 8½" x 11" CATALOG NO. 43-44. It gives complete data on fillet welded Open Steel Flooring and Stair Treads.

WALTER BATES COMPANY, INC.
JOLIET • ILLINOIS
OPEN STEEL FLOORING • STAIR TREADS

development program for Portland. It involves an estimated expenditure of about $12 million, based on late pre-war prices. Main features include sewers on both sides of the Willamette River and adjacent to Columbia Slough, to intercept the flow from more than 60 outfalls from district sewer systems. A number of large low-head pumping stations will be required and the sewage will receive primary treatment for removal of grease and settleable solids before discharge into the Columbia River. The intercepting system will have a capacity approximating 200 mgd. and the treatment plant will be designed to handle approximately one-half that volume.

For many years there has been agitation for the removal of serious pollution from waters of the entire Willamette River watershed, and Portland is now undertaking its share in the program. For several years the city engineer carried on factual investigations which are now made available to the designing engineers.

In 1939 an engineering board of review consisting of Abel Wolman of Baltimore, Wellington Donaldson of New York, R. H. Corey and Carl E. Green of Portland, in a preliminary study of the project made recommendations which are the general basis for the work which is now undertaken.

Ben S. Morrow, city engineer, will cooperate with the designing engineers so that all phases of the project may be suitably coordinated with other construction activities which may soon be initiated. The construction work, which it is planned to undertake as a postwar job, will be under the direction of an engineering board consisting of the city engineer, Ray E. Koon and John W. Cunningham.

• • •

Used equipment ceiling raised for lend-lease

At the urgent request of the War Production Board, the Office of Price Administration has increased the ceiling prices which can be paid to contractors, dealers, and others on certain types of used construction equipment for shipment through lease-lend to England. The increase varies from five to 15 percent over present ceiling prices, which are those prevailing before 1939.

All such equipment is to be purchased by the U. S. Engineers. While it was originally planned for the engineers to purchase that to be shipped for troop use, that which is intended for use in England's coal mines was to have been purchased by treasury procurement. Since the Army is already set up to make inspections and handle the equipment, and since the procurement di-

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Blue Brutes in wartime girdle the globe. Colored olive drab for Army, battleship gray for Navy, they speed the flight of Fortresses from jungle air fields, help keep shell-shocked roads in occupied territories open to military traffic, and help build cantonments in the Arctic. On the Alcan highway, in Australia, on the Mediterranean fronts — and in hundreds of Army camps, Navy yards, air bases and ordnance plants here at home — Blue Brutes help the men who fight for our future. Your nearest distributor is listed on page 126.

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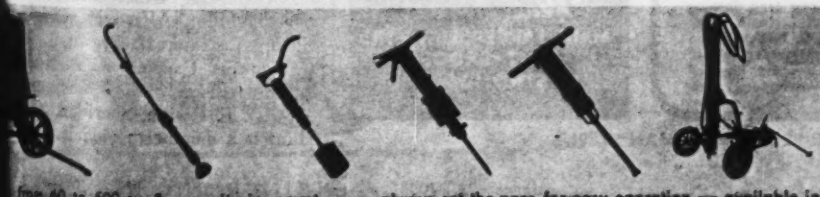

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Bucket agencies throughout the country. Write, wire for prices, delivery and catalogs.

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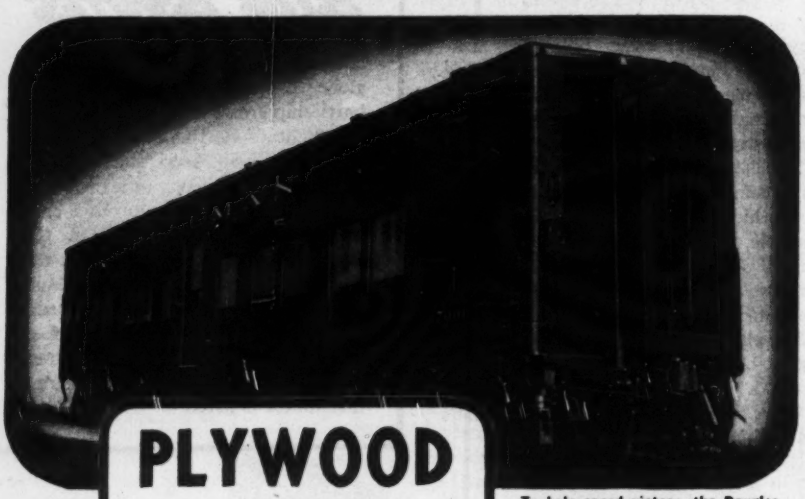

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● Designed to carry 30 fighting men in triple-deck berths, these new-type sleepers were produced at a rate of 12 to 18 a day . . . are the first in U. S. history to be built exclusively for troop transport. Write for information to Douglas Fir Plywood Association, Tacoma 1, Washington.

To help speed victory, the Douglas Fir Plywood industry is devoting its full productive capacity to war.

DOUGLAS FIR PLYWOOD
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MADE LARGER, LIGHTER
SPLIT-PROOF
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vision is said not to be, it was decided that all of the specified items should be handled by the Army.

For crawler tractors and equipment mounted on tractors but not tractors towed, where items are rebuilt and guaranteed, the ceiling is increased from 85 to 90 percent of the new base cost of 1939 or later models. On items not rebuilt and guaranteed, the price is increased from 55 percent to 60 for 1939-40-41 models, and to 65 for models built since then.

For all other types of construction or roadbuilding equipment, rebuilt and guaranteed items will also bring 90 instead of 85 percent of cost for all models of 1939 or later; while those not rebuilt and guaranteed will be increased from 55 to 65 percent for 1939-40-41 models and 70 percent for later models. It is hoped that some equipment will be acquired which does not require overhauling. That is the reason for the more favorable ceiling prices in late models.

"The War Production Board," OPA's letter of affirmation to the Army Service Forces says, "wants to avoid the sharp increase in the demand for repair parts that probably would result if purchases for a project of such proportions were comprised largely of old equipment."

Contractors and dealers willing to dispose of any required pieces are reminded that because of scarcity of gasoline in England, only diesel and steam engine types or large units of machinery to be used in the mines will be purchased. For troop use, gasoline types also will be acceptable.

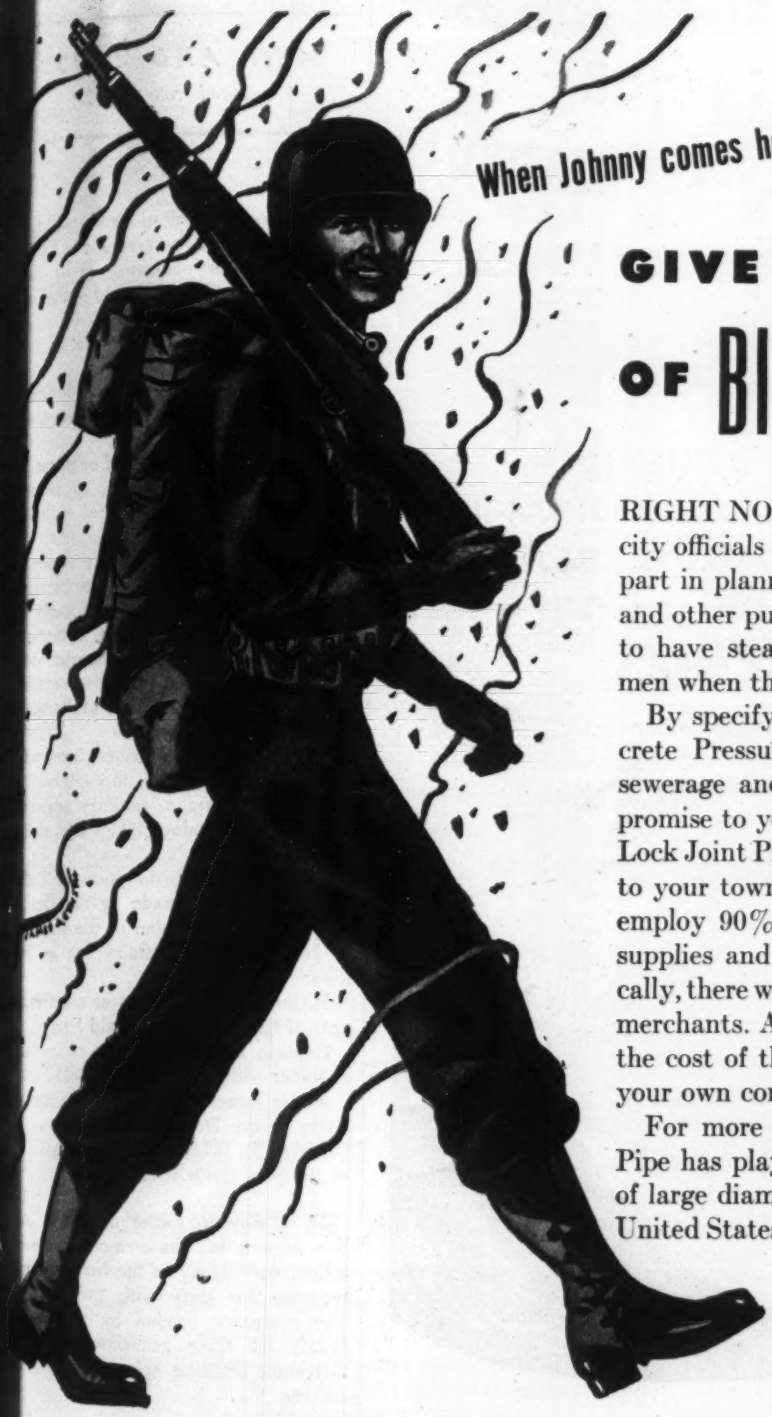
This places a limit on the amount of large units available for the mines, since the steam-engine types have not been manufactured since about 1930.

. . .

Wyoming forms postwar planning committee

Establishment of a 10-member executive committee to develop a postwar construction program for Wyoming has been announced by Gov. Lester C. Hunt. The committee held its first meeting Feb. 11-12 jointly with the 25th annual meeting of the Wyoming Engineering Society in Cheyenne.

Earle G. Burwell of Casper was elected chairman of the state postwar planning committee. Dr. Henry G. Fi... of Laramie was named vice president and Geo. O. Houser, Cheyenne, secretary-treasurer. Other committee members include: Alfred M. Carey, Re... Springs; Frank H. Brown, Lovell; C. Tonkins, Casper; W. A. Norris a... Archie Allison, both of Cheyenne; a... Mrs. D. E. Gwinn, Sheridan. Gover... Hunt is a member, ex-officio.



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GIVE HIM PLENTY OF BIG JOBS TO DO

RIGHT NOW, on the home front, it's up to city officials and leading engineers to do their part in planning new municipal water mains and other public works projects. It's one way to have steady employment ready for local men when their present job is finished.

By specifying Lock Joint Reinforced Concrete Pressure Pipe for water supply lines, sewerage and drainage, you can fulfill your promise to your own returning men. For, the Lock Joint Pipe Company is prepared to come to your town, set up a temporary plant and employ 90% of local labor. As most of the supplies and materials will be purchased locally, there will be a direct benefit to your town merchants. As a result, a large proportion of the cost of the project will be spent right in your own community.

For more than three decades Lock Joint Pipe has played a vital part in the majority of large diameter water pipe contracts in the United States. When Victory comes, we stand ready to help you give your engineers, mechanics, carpenters, laborers and other skilled workers the jobs they will need.

Whether your project is large or small, for the present or the future, your 'phone call, telegram, cable or letter to any of our offices will bring a prompt reply.

LOCK JOINT PIPE COMPANY

Established 1905

AMPERE, NEW JERSEY

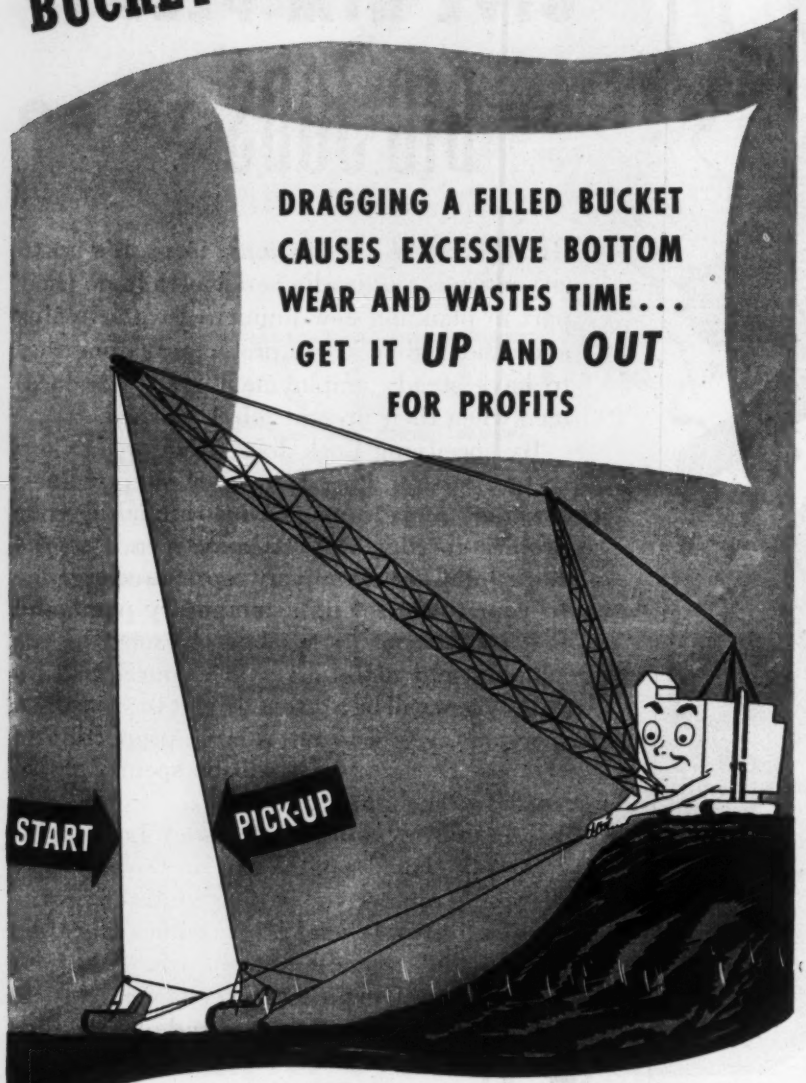
Denver, Colo. • Chicago, Ill. • Kenilworth, N. J. • Kansas City, Mo. • Rock Island, Ill. Joplin, Mo. • Valley Park, Mo. • Cleveland, Ohio • Hartford, Conn. • Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply Mains as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

LOCK JOINT Reinforced Concrete PRESSURE PIPE

DRAGLINE PRODUCTION TIP NO. 2

PICK UP THE BUCKET AS SOON AS LOADED!



Within 1 or 2 bucket lengths, a Page AUTOMATIC Dragline Bucket *digs, fills* and *carries* a full pay load. Size for size and weight for weight a Page AUTOMATIC will OUT-DIG any other dragline bucket made!

PAGE *Automatic* DRAGLINE BUCKETS

PAGE ENGINEERING COMPANY, CHICAGO 38, ILLINOIS

MEN AND JOBS

(*Continued from page 73*)

Promotions in rank of members of the Army Sanitary Corps assigned to Latin American posts operating under the jurisdiction of the health and sanitation division of the Office of the Coordinator of Inter-American Affairs, are as follows:

Harold B. Gotaas, assistant director, Institute of Inter-American Affairs, to lieutenant-colonel.

W. Martin Johnson, chief engineer of the Mexican Field Party, to major.

Benjamin A. Whisler, chief engineer of the Peru Field Party, to captain.

Emil T. Chanlett, sanitary engineer with the Brazil Field Party, to captain.

S. Ladd Davies, sanitary engineer with the Panama Field Party, to captain.

E. L. Dudley, sanitary engineer with the Venezuela Field Party, to captain.

Wyman R. Stone, Chief of Party in Ecuador, to captain.

Paul C. Ward, sanitary engineer with the Brazil Field Party, to captain.

Clyde T. Norman, sanitary engineer with the El Salvador Field Party, to 1st lieutenant.

New assignments to posts in Latin America recently made by the Health and Sanitation Division of the Institute of Inter-American Affairs are as follows:

Major A. J. Kranaskas as chief engineer of the Uruguayan Field Party.

Captain William A. Stone as sanitary engineer with the Peruvian Field Party.

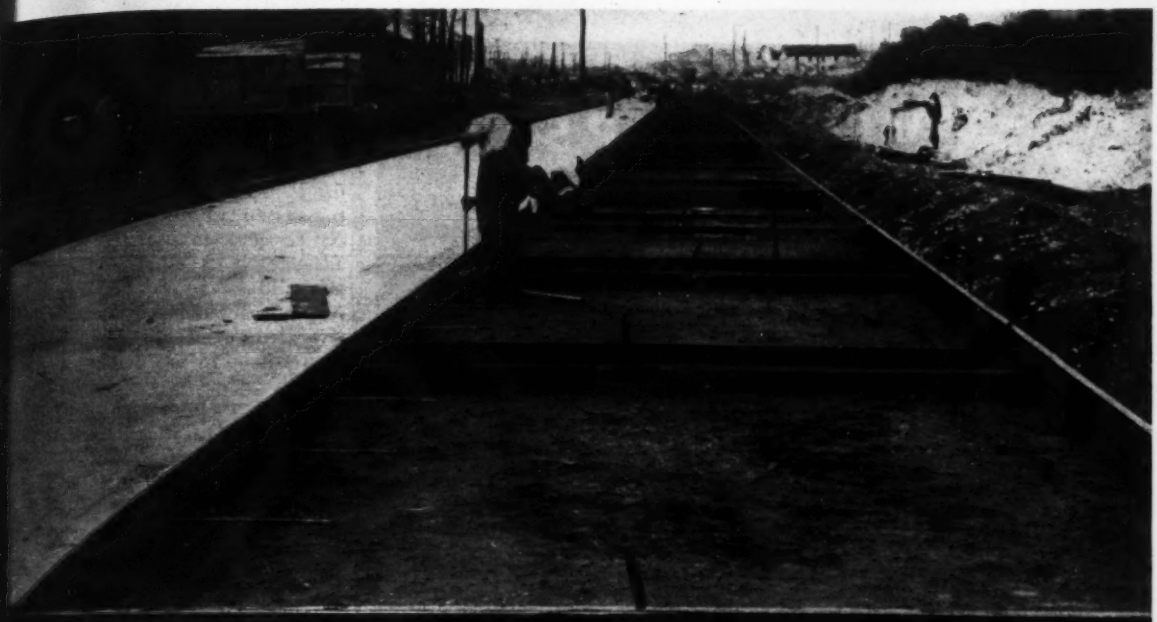
Major James D. Caldwell as Chief of Party in the Dominican Republic.

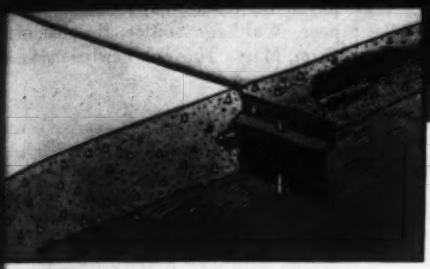
Major R. R. Harris as Acting Chief of Party in Costa Rica.

H. J. Cowan, owner of Cowan and Son, Algona, Ia., has been commissioned a lieutenant (j.g.) in the Navy and has reported for duty with the Seabees. The company, headed by the Cowan family for three generations, expects to resume building operations when he returns.

J. R. Bromley, Wyoming state highway construction and maintenance engineer, has been appointed to succeed J. G. Smith as Wyoming state highway superintendent, effective March 1. Mr. Smith resigned to return to the A. H. Read Co., contractors, which he left in July, 1943, to become superintendent.

John W. Tanghe, supervising engineer, department of public works, Milwaukee, Wis., since 1930, has been appointed deputy commissioner of the





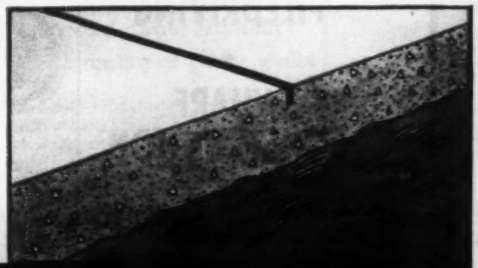
For Maximum Load Transmission
USE
KEYSTONE TONGUE and GROOVE JOINT

There are no "blow-ups", no "rough-riding" surces when Keystone Center Strip is used. The keyed-int principle allows for normal expansion and ntraction and distributes the load without crack-g. Specify it for concrete highways, runways and dustrial floor areas.

This pre-moulded asphalt mastic board joint is rigid, waterproof and flexible, and can be used both longitudinally and transversally. It's easily installed, available for immediate shipment and is approved by U. S. Engineers, Navy Department and State Highway Departments. Write for samples.

WHEN YOU HAVE TO KEEP COSTS DOWN....Specify
KEYSTONE ASPHALT MASTIC DUMMY STRIP

here "weakened plane" type construction joints are required, eystone Dummy Joint provides low cost, ease of handling and raight alignment without expensive installing machinery. Fur-shed in full size sheets—⅛" thick—and scored to the required idth, it is absolutely waterproof and offers maximum rigidity.



VING PRODUCTS CATALOG... for ready reference on Keystone's complete line f paving products—engineer-approved and meeting state and federal speci-ations—have a copy of the Keystone Catalog in your files. Write Dept. K.

Keystone
ASPHALT PRODUCTS CO.
A DIVISION OF AMERICAN-MARIETTA CO.

GENERAL OFFICE
43 E. OHIO STREET... CHICAGO 11, ILL.
MANUFACTURING PLANT • CHICAGO HEIGHTS, ILL.

PREMOULDED ASPHALT AND FIBRE EXPANSION JOINTS AND ACCESSORIES
JOINT SEALING COMPOUNDS AND CRACK FILLERS

Mall

VIBRATORS

PLACE More Concrete FASTER with LESS Labor

★★ Immediate delivery on Gasoline Powered 1½ H.P., and wheelbarrow or round base mounted 3 H.P. units on suitable priority.

★ GREATER CAPACITY—for their size MALL Portable Vibrators place more concrete than any other vibrator.

★ HIGH FREQUENCY VIBRATION (7000 per min.) makes for greater uniformity, in strength and density of concrete.

★ PLACE A STIFFER MIX—than can be puddled by hand, eliminating honeycombs and voids.

★ INCREASE BONDING STRENGTH—with reinforcement and between successive layers.

★ VARIABLE SPEED GASOLINE ENGINE—starts easily, uses very little fuel, and supplies abundant power for 8 other interchangeable tools.

MALL Vibrators are ruggedly constructed for long hard usage. Vibrating elements are made of the toughest materials with special metal, welded tips designed to withstand constant abrasive action.

Ask your Distributor or Write for full details.

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Offices and Distributors in Principal Cities

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excellent facilities are available for

BULKHEADS
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MARINE RAILWAYS

PHONE, WIRE OR WRITE US

DELAWARE BAY SHIPBUILDING CO., INC.
LEESBURG, NEW JERSEY

They Can Take It

DUAL PRIMERS

When it comes to DURABILITY, CMC Dual Primers have the "guts" to stand up to those tough, steady 24-hour grinds. DUAL PRIME means unmatched performance and priming speed.

A husky 3" CMC Dual Prime. One of the complete line from 1½" to 10" sizes. Also 3" and 4" Diaphragms. Get catalog.

CONSTRUCTION MACHINERY CO.
Waterloo, Iowa
Mixers • Pumps • Hoists • Batching & Placing Equipment • Saws • Carts • Barrows

department to fill the unexpired term of the late William Esser. Mr. Tanghe is a civil engineering graduate of the University of Wisconsin, 1916.

H. D. Brice, assistant engineer with the U. S. Geological Survey, has been transferred recently from the Albany, N. Y., office to a residency office at Jamaica, N. Y., and placed in charge of stream-gaging activities in Westchester, Nassau, and Suffolk counties. Mr. Brice is a civil engineering graduate of the University of Iowa.

Col. R. P. Rosengren, chief of the Technical Information Branch, Office of the Chief of Engineers, has been transferred to England. **Maj. W. M. Hurley,** who has been with the branch for some time, has succeeded him as chief.

Andrew H. Peterson, attached to the Boston offices of the U. S. Engineer Department, has been appointed area engineer, Waltham Station Hospital, Waltham, Mass. This is a newly established area.

Duncan Mills, who has served in various executive capacities in the War Relocation Authority, has been appointed acting project director of the Colorado River Relocation Center at Poston, Ariz., succeeding **W. Made Head.** He has also served with The Resettlement Administration; and was with the Soil Conservation Service at Albuquerque, N. M., for five years. Mr. Head, who has been director of the relocation center since its establishment early in 1942, has returned to his position with the Indian Service.

Walter M. Kunsch, formerly superintendent of sewage disposal at Danbury, Conn., and more recently employed in a similar capacity at the Davisville, R. I., Naval Depot, has accepted the appointment as engineer-manager of the Urbana-Champaign, Ill., Sanitary District. He succeeds **W. H. Wisely,** who resigned to devote full time to his duties as executive secretary of the Federation of Sewage Works Associations.

Changes in the engineering personnel of the New York Central railroad system, effective recently, as announced by F. J. Jerome, chief engineer, include the assignment of **J. A. Stocker,** district engineer, NYC-Line West, at Cleveland to other duties. **G. T. Donahue,** assistant district engineer, Cleveland, has been promoted to district engineer there. **R. R. Smith,** division engineer, NYC-Line West at Toledo, Ohio, is the new assistant district engineer, Michigan Central R.R., Jackson, Mich., succeeds Mr. Smith as division engineer at Toledo. **E. G. Brisbin,** assistant engineer on the

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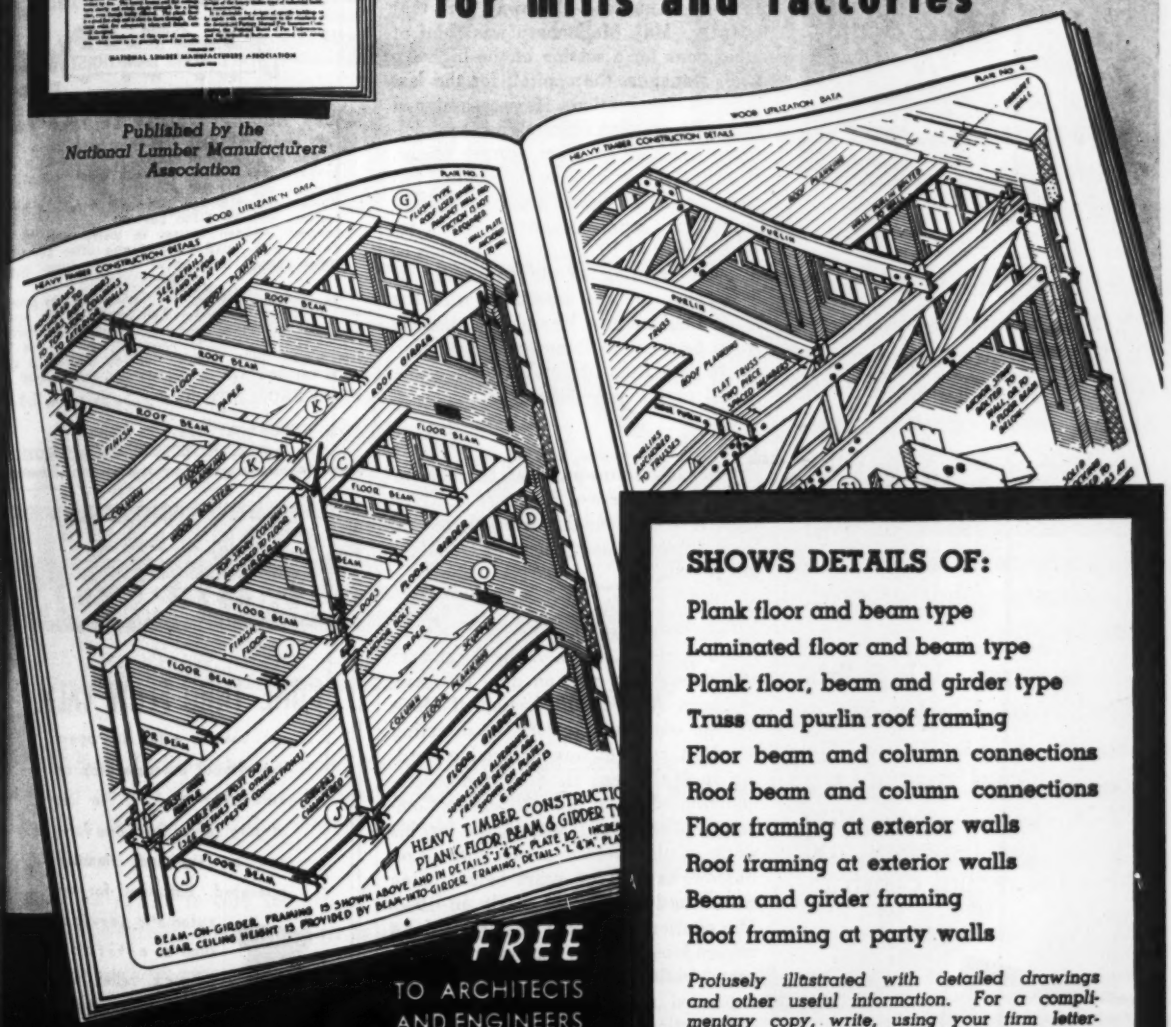
Details of HEAVY TIMBER CONSTRUCTION

for mills and factories



FREE
TO ARCHITECTS AND ENGINEERS

SHOWS DETAILS OF:

- Plank floor and beam type
- Laminated floor and beam type
- Plank floor, beam and girder type
- Truss and purlin roof framing
- Floor beam and column connections
- Roof beam and column connections
- Floor framing at exterior walls
- Roof framing at exterior walls
- Beam and girder framing
- Roof framing at party walls

Profusely illustrated with detailed drawings and other useful information. For a complimentary copy, write, using your firm letterhead, to The Timber Engineering Company, Washington, D. C., and Portland, Oregon.

For Modern Timber Construction *Specify* **TECO** Timber Connectors and Tools

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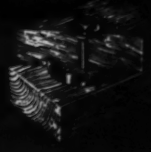
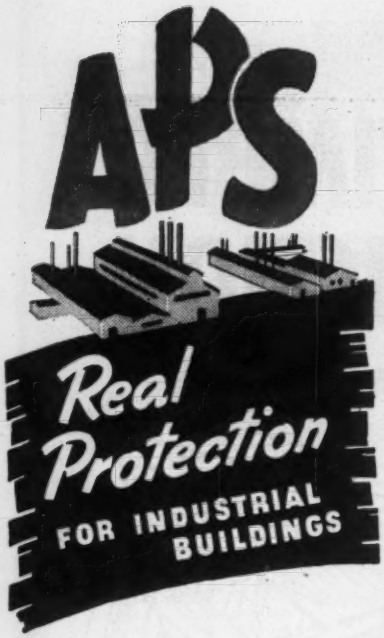
NATIONAL MANUFACTURERS OF **TECO** TIMBER CONNECTORS AND TOOLS

WASHINGTON CHICAGO MINNEAPOLIS NEW ORLEANS PORTLAND



The **TECO** Ring Connector spreads the load on a timber joint over practically the entire cross section of the wood, brings the full structural strength of lumber into play.



A P S Protected Steel Roofing and Siding is *Weather-Tested!* Under the most severe conditions, A P S Sheets have proven superior in actual service, withstanding industrial acid fumes and gasses, as well as exposure to salt laden air, extreme heat or cold, and moisture.

Easy to erect, A P S Protected Steel Sheets are a favorite with industrial, chemical and canning plants, storage sheds and warehouses, fisheries, and other essential construction.

PROTECTED STEEL PRODUCTS

General Office and Plant, WASHINGTON, PA.

Michigan Central at Bay City, Mich., is the new division engineer at Jackson, and **J. W. Westwood** succeeds Mr. Brisbin as assistant division engineer at Bay City.

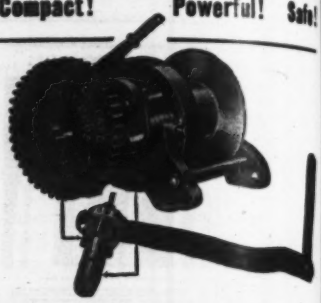
Award of the Nicaraguan Medal of Distinction to **Maj. Joe E. McEachern,** Memphis, Tenn., was announced recently by Army officials at the Panama Canal Department headquarters. The presentation was made by President Anastasio Somoza of Panama in recognition of important service rendered in the construction of the recently completed portion of the Pan-American highway in that country. Maj. McEachern was chief of operations for a section of the highway near Managua, the capital, for the last year of construction. He was assigned to the Nicaraguan project after completing a year as engineer supply officer. Previously, he was employed for two years by the Panama Canal as a civilian engineer. Commissioned an Army reserve officer in 1931 upon completion of military training at the University of Tennessee, he was associated with the U. S. Engineers at Memphis until 1939 when he went to Panama. He entered active duty Aug. 20, 1941, and was promoted to the rank of major Sept. 15, 1942.

C. Frank Johnson, chief engineer of the Commissioners of Sewerage at Louisville, Ky., will end his work there and leave for a new assignment at Honolulu this month.

Col. Ralph G. Barrows, formerly division engineer, U. S. Army Engineers at Chicago, and now on duty overseas, has been awarded the Legion of Merit for his outstanding work in directing the production of war material, according to Maj. Gen. H. S. Aurand, commanding officer of the 6th Service Command. The award was made for his work in the Detroit area, where Col. Barrows served two years before being transferred to Chicago early in 1943. The citation states that he carried out a tremendous military construction program, built air fields and cantonments, expanded industrial plants, and directed construction of the MacArthur Lock at Sault St. Marie, Mich., "completing in 14 months a structure which in normal times would have required three years." Col. Barrows was born in Cleveland and was graduated from West Point in 1916.

It was announced at Maysville, Ky., Feb. 18, that **Walter T. Rye,** Waynesburg, rural highway commissioner of the Kentucky state highway department for twenty-six years, had resigned that post to become superintendent of construction with the Ralph E. Mills Construc-

Compact! Powerful! Safe!



DISTRIBUTABLE CONTROLLED POWER

with **BEEBE BROS. ALL STEEL HAND HOIST**

SEATTLE, U.S.A.

Money Has Been Saved on These Jobs

1200' assembled pipe (132 Tons) were lowered to bed of Mississippi at St. Paul with 9—5-Ton Beebes, three lines to each hoist through blocks.

Hudson River Bridge sidewalks were laid in sections with 32—5-Ton Beebes.

Longest wooden trusses in world were installed with ONE 5-Ton Beebe after power hoists proved impractical.

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When raising, lowering, or placing costs by power are a serious problem, the answer is the right number of Beebe Bros. All Steel Hand Hoists MANNED IN UNISON. Available in 2, 5 and 15 Ton sizes. Sold through leading dealers in all trade centers. List of dealers sent upon request.

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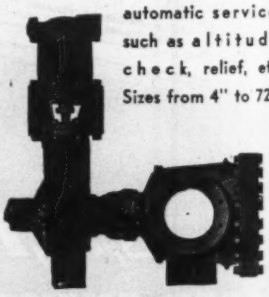
"THE STRONGEST GEARED POWER FOR ITS WEIGHT IN THE WORLD"

GOLDEN-ANDERSON

CONE THRU-FLOW VALVE

. . . assures a full line opening without pressure drop on automatic services. In lieu of gate valves the Cone Valve can be supplied manually operated. Furnished for any automatic services such as altitude, check, relief, etc. Sizes from 4" to 72".



GOLDEN-ANDERSON VALVE SPECIALTY CO.

PITTSBURGH PENNA.

For Air Economy USE Thor ROCK DRILLS

AIR INPUT Measured to .00025 of an inch for Balanced Power and Smooth Performance.

Spaces between the flanges and chest shoulders of this patented Thor Valve are controlled to a tolerance of .00025 of an inch to turn into power ALL air that enters the tool.

• Thor Rock Drills develop rock-smashing power and speed from every ounce of air that enters the machine through the patented Thor Positive Short-Travel Tubular Valve which controls air power by tolerances of .00025 of an inch!

Balanced power is one feature of such fine control—because only a precisely governed quantity of air is allowed behind the piston.

Smooth performance is another feature—because every stroke is powered by the same measured quantity of air.

And *air economy* is assured throughout the life of the Thor Rock Drill—because there are no separate parts of this patented Thor valve to lose or wear.

Thor Rock Drills offer many more features of design and construction—features providing complete control of drilling speeds, assuring dependable rotation, preventing clogging, and absorbing shock. For complete details about Thor Rock Drills and a wide range of associated air tools write today for Thor Catalog 42-A.

OTHER THOR AIR TOOLS
PAVING BREAKERS • CLAY DIGGERS • TAMPERS • SUMP PUMPS • GRINDERS • SAWS

Thor *Portable Pneumatic and Electric Tools*

INDEPENDENT PNEUMATIC TOOL COMPANY

600 W. JACKSON BOULEVARD, CHICAGO 6, ILL.
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Portable pipe lines, composed of 20-foot sections easily handled by one man, followed our advancing forces across the desert. The wide range of Naylor Pipe sizes from 4" to 20" in diameter makes this pipe ideal for numerous post-war applications in the construction field.

DESERT DRINKING FOUNTAIN

Hundreds of miles long!

NAYLOR PIPE PERFORMANCE ON THE BATTLE FRONTS SETS THE STAGE FOR POST-WAR APPLICATIONS IN THE CONSTRUCTION FIELD

In the battle for North Africa, water and gas supply lines had to be provided in a hurry to keep men and machines supplied all along the advancing front.

A continuous "drinking fountain" in the form of hundreds of miles of portable pipe, quickly assembled over the rough terrain, met the challenge of desert warfare, and is credited by the Army with having helped materially in the victory.

The part played by Naylor Pipe in keeping our fighting men supplied again emphasizes the structural advantages offered by Naylor's exclusive Lockseam Spiralweld. For all its light weight, this distinctive pipe has long demonstrated its greater strength, flexibility, leak-tightness and safety in pipe line construction.

Naylor light-weight pipe with standard weight ends and standard pipe connections provides an unbeatable combination in peace as in war.

Naylor

NAYLOR PIPE COMPANY

1248 East 92nd St. • Chicago 19, Illinois

tion Co., Mann., W. Va., large highway builders operating in several states.

T. L. Latimer has been named city engineer of Provo, Utah, succeeding Elmer A. Jacob, resigned.

H. E. Bailey, city manager of Oklahoma City, Okla., has resigned to return to the Oklahoma State Highway Commission as chief engineer. He will prepare and direct the postwar construction program and reorganize the maintenance department.

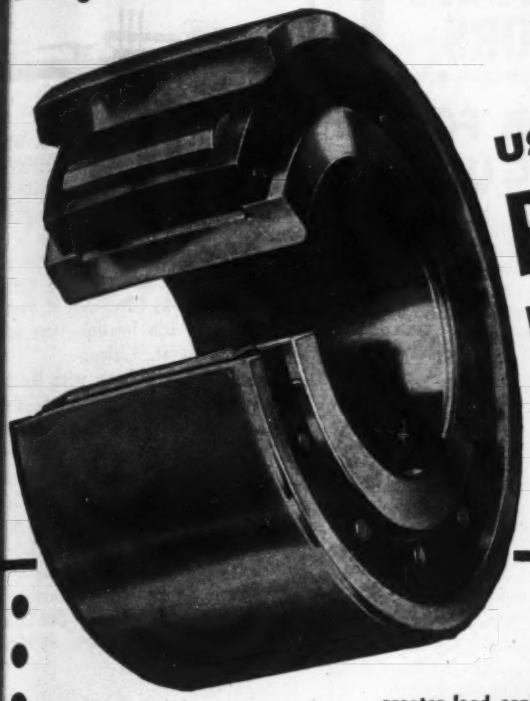
Ambrose Burton of Wakefield, a suburb of Boston, Mass., is the commanding officer of a base squadron at the Pope Field Army Base, N. C., an installation of the First Troop Carrier Command. Prior to entering the service, he was a construction engineer and supervisor for the B. R. Switzer Co. of Boston, specialists in bank building. Major Burton supervised three of the eight such jobs for the National Shawmut Bank of Boston alone. The largest building he worked on was the State Office building in Boston, and the biggest construction job he directed was the New England Aircraft School. Major Burton is a graduate of Tufts College, earning his B.S. in civil engineering.

Francis B. Marsh, formerly division engineer, Board of Water Supply, New York City, has been made associate editor of *Water Works Engineering*. Mr. Marsh is a graduate of Dartmouth and Thayer School of Civil Engineering. Following his graduation he spent about a year on the editorial staff of *Engineering Record*. For almost all of his forty years in the engineering field, Mr. Marsh has been in water-supply work. For five years he was on the planning and construction of the new Delaware water system for New York City.

Orville T. Upp, Ottumwa, Ia., engineer of Wapello County, resigned to become Davis County engineer. Thomas E. Riley, Worth County engineer for the last four years, has been engaged to replace Upp in Wapello County.

Henry A. Brandis of Brooklyn, the only engineering instruction repairman in New York City's subway service, retired from the Board of Transportation on his 76th birthday recently. Mr. Brandis has been granted extensions beyond the age limit of 70 because of his unusual vigor and activity. His record for consistent attendance, punctuality and efficiency in his work is said to be without parallel in the city's service. Maintenance and servicing of precision engineering instruments is the only type of work he has ever done.

Design Now for Higher Hourly Production After the War



Type MCS
Double Width

use ROLLWAY Right-Angle BEARINGS to Carry the Load...

Production rates per man and machine-hour rose sharply after the last war. They'll go higher after this war. That's why postwar machines MUST be designed for heavier loads and higher speeds. And that's why the greater load capacity, the longer bearing life, and the lower maintenance costs of Rollway Right-Angle Roller Bearings are vitally important to your postwar designs, right now.

Rollway Right-Angle Loading Reduces the Unit Load

For compound loads, diagram shows how SEPARATE radial and thrust bearings are used in combination:

- **All radial loads carried at right angles to the roller axis**
- **All thrust loads carried at right angles to the roller axis**

Right-Angle loading limits the load carried by each bearing to a single, simple load component—*either pure radial or pure thrust*. Thus the unit load per roller is lower, the load capacity for a given dimensional limit is higher. No oblique loads or resultants, no other compound loads can pile up to increase the magnitude of the simple radial or thrust component. Resistance to shock and vibration is increased. Pinch-out of rollers is eliminated—there's less rubbing friction, and less wear-back of roller ends. The net gain is clearly apparent in longer bearing life and lower maintenance cost.

Standard Sizes for Most Applications

S.A.E. or American Standard metric dimensions and tolerances in a wide range of sizes and types assure low cost and ready availability for most applications. Special designs are rarely necessary. Let our engineers help you select the types best suited to your needs. Just send a drawing or detailed description for free, confidential analysis and recommendation. No obligation.

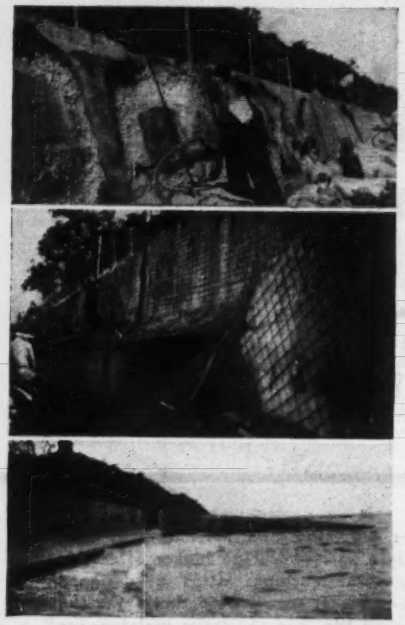
ROLLWAY BEARING COMPANY, INC., SYRACUSE, NEW YORK

BUILDING HEAVY-DUTY BEARINGS SINCE 1908 **BEARINGS**

CEMENT GUN COMPANY

"GUNITE" CONTRACTORS

GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



NEPTUNE FOILED WITH "GUNITE"

The estate of Harry E. Guggenheim, Port Washington, L. I., N. Y., is bounded by a concrete sea wall about a mile long. Within a few years after construction, this wall was badly eroded and in some places almost destroyed by the action of salt water. In 1936 we reintegrated with reinforced "GUNITE" 2,400 feet of this wall and in 1940 an additional section of 1,800 feet. In both cases, the destructive action of the ocean was permanently halted. The upper photo shows ravages at the time of the second contract; the middle view is of reinforcing placed preparatory to applying the "GUNITE." At bottom is the completed job. A nominal thickness of 2½" "GUNITE" was used but in some areas multiple mesh was required to fill out deeply eroded portions.

Our Bulletin 2200 describes many protective and restoration jobs we have done with "GUNITE." Write for a copy.

MANUFACTURERS OF THE "CEMENT GUN"

BIG JOBS AHEAD

for YOU...

with JACKSON VIBRATORY HAND SCREED!

But before you tackle the big Post-War concrete contracting jobs, get acquainted with the wide scope in concrete surfacing operations offered by the JACKSON SC-4A vibratory hand screed. Its advantages include lightweight, uniform vibration and adaptability to reasonable widths of section. Gives complete puddling to low-water content concrete. Write for further details.

ELECTRIC TAMPER & EQUIPMENT CO.

LUDINGTON MICHIGAN

MANUFACTURERS' ACTIVITIES

APPOINTMENT of William O. Wil of Evanston, Ill., as a commercial v president of Worthington Pump Machinery Corp., has been announc Mr. Wilson will be responsible for g eral direction of all of Worthingto commercial activities in the Chica St. Louis, Kansas City, and St. Paul t ritories, with his headquarters at West Madison St., Chicago.

Mr. Wilson has been with Worthi ton and its predecessor companies si 1898, except for a two-year period st ing in 1911, when he was employed construction engineer for Americ Water Works and Guarantee Co. 1919, Mr. Wilson was appointed distr manager at Pittsburgh, and in 1928 w transferred to Chicago. Since 1937 has been manager of Worthington's m west district, comprising the Chica St. Louis, Kansas City, and St. Paul d trict office territories.

N. I. MEKEEL, JR., has been appoint manager of the grating departm of the Blaw-Knox Division of Blaw-Knox Co., succeeding Elmer E. Brodhead, former manager, who has formed a business connection on the west coast.

Mr. Mekeel was assistant manager of the grating department for the past three years a previously was a manufacturer's ag for steel products in the eastern pa of the country.

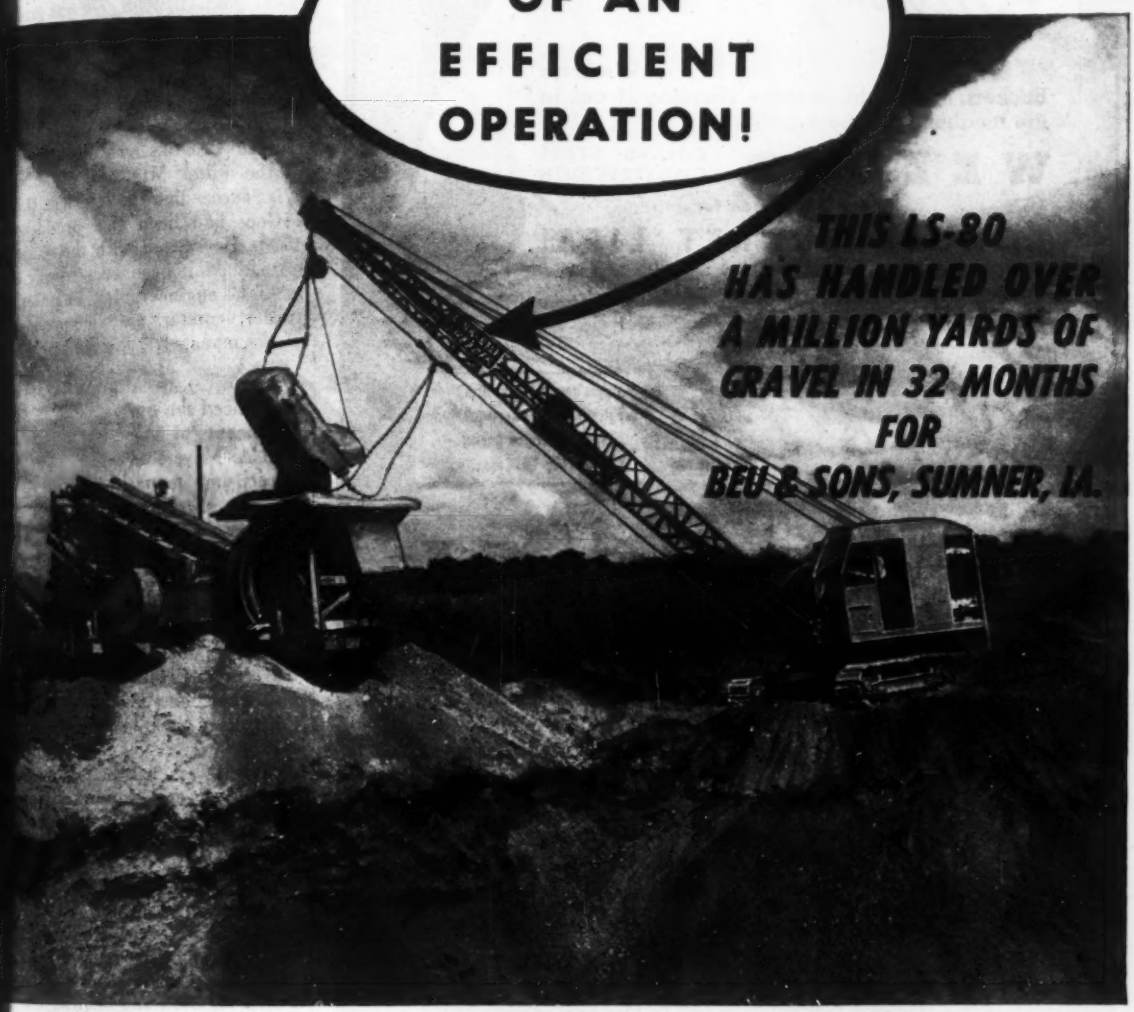
THE MEEHANITE METAL CORP., N Rochelle, N. Y., has granted manufa turing rights for Meehanite castings the Indian Hume Pipe Co. of Wadal Bombay, India.

W. H. Moore, formerly of Chatt nooga, Tenn., who has been in India f some time, has been appointed technic manager of the Meehanite Metal Cor in India.

THE BALDWIN LOCOMOTIVE Works h appointed C. E. Kraehn as assistant V. H. Peterson, who is in charge of sal

Mr. Kraehn joined the Baldwin o ganization last year after an associati of 24 years with General Electric C He started with that company in 19 at Schenectady, and in 1922 moved

A SURE SIGN OF AN EFFICIENT OPERATION!



BUY BONDS
★ AND ★
MORE BONDS

Contractors all over the United States have found that there is extra profit in the extra strength and stamina built into these finger-tip operated machines. They are engineered for long, maintenance-free service and are giving that service even under the stress of war-time strain. There are 25 different models available—a type and size to fit every job.

8445

LINK-BELT SPEEDER

Builders of the Most Complete Line of
SHOVELS-CRANES-DRAGLINES

LINK-BELT SPEEDER CORPORATION, 301 W. PERSHING ROAD, CHICAGO 9, ILL.
A DIVISION OF LINK-BELT COMPANY

WELLMAN WILLIAMS TYPE BUCKETS

Staying Power

Wellman Buckets stay right in there slugging it out in the toughest, roughest going.

WELDED ROLLED STEEL CONSTRUCTION is one big reason for LONGER BUCKET LIFE!

Send for Free Bulletin

Tell us about your particular requirement and we will send full description of construction and special features in bulletins which clearly proves why YOUR NEXT BUCKET SHOULD BE A WELLMAN-WILLIAMS.

Multiple Rope & Power Arm Types
Dragline • Power Wheel • Dredging
Special Service Buckets
⅜ to 16½ Yd. Capacities

THE WELLMAN ENGINEERING COMPANY
7000 Central Ave. Cleveland 4, Ohio
Sales and Service Agencies in principal cities

the New York district office, wher served in various sales capacities 1937. From 1937 to 1942 he was signed to the company's Boston This was followed by a year with International General Electric Co New York, from which he resigne take a post with Baldwin.

Mr. Kraehn was born at Buf N. Y., Dec. 20, 1896. He was gradu from Rensselaer Polytechnic Institu 1918, and immediately entered the Navy, serving at sea as a commissi officer with engineering duties.

FRED T. GOES was elected presi of the Vilter Mfg. Co. of Milwau Wis., succeeding the late Wm. O. V Goes had been vice president 1938. He started with the compan 1915, having been successively est tor, sales engineer, plant engineer, c troller, secretary and vice president works manager.

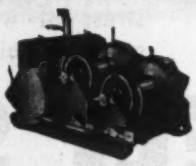
LEROI CO. OF MILWAUKEE, WIS. announced the appointment of Alfred A. Meyers as advertising manager. Mr. Meyers in 1926 went with the Harnischfeger Corp. and advanced to assistant advertising manager. He remained there until last fall, when he went to the A. O. S Corp. as a member of the advert staff.

Mr. Meyers has had more than years of special training in advert design and industrial arts. As a r he reflects his knowledge in the qu of the work he is turning out at Le

THE CLYDE EQUIPMENT CO., form owned by eastern interests, has taken over by a group of employees, will operate the concern's two offic Portland, Ore., and Seattle, Wash. new president is Oscar B. Bjorge, of the Portland office, and the vice p

LEWIS & McDOWELL Inc.
Engineers & Contractors
for
Prestressed Gunite Tanks
Gunite work in all its Branches
Waterproofing, all types
Restoration of Masonry Buildings
Synthetic Rubber and other special Tank Linings
Dam Repairs and Reconstruction
285 Madison Avenue, New York, N. Y.
Murray Hill 3-0554

STERLING QUALITY
YOU'LL GET BETTER RESULTS WITH STERLING
WRITE FOR LITERATURE
STERLING HOISTS



Simple, Dependable, Rugged—Sterling Hoists, Pumps, Light Plants are the choice of leading users.
STERLING MACHINERY CORP.
4051 3 Southwest Blvd. Kansas City, Mo.

Diamond Core Drilling Contractor
FOUNDATION TESTING
Dams, Heavy Structures, etc.
STAGE SECTIONAL PRESSURE GROUTING
Contract or Rental
MFR'S DIAMOND & SHOT CO
DRILLS GROUT MIXING MACHIN
PACKERS AND GROUT PUMPS
MOTT CORE DRILLING C
HUNTINGTON, W. VA.

OU CAN'T JUST HAND A MAN A BRUSH AND SAY:

PAINT THAT BRIDGE!"

If that's all there was to it, bridge maintenance costs would be a lot lower than they are. Bridge painting, however, involves much more than the mere application of paint on steel.

Organization, management, equipment, materials . . . and just as important . . . specialized skill, are the vital factors that make it possible for Morrison to say, that because of our wide experience and knowledge of Bridge Construction . . . *we can do it better for less.*

With this background, we would like you to consider Morrison Railway Supply when you are faced with a bridge painting problem.

MORRISON
RAILWAY SUPPLY CORP.
EXECUTIVE OFFICES . . . BUFFALO 12, N. Y.
CHICAGO 4, ILL. BIRMINGHAM 3, ALA.

WYTEFACE
"A"
TRADE MARK
STEEL TAPES

GRADUATED IN INCHES OR TENTHS

EASY-TO-READ, *raised* black graduations on crack-proof white surface . . . resist abrasion from rock, sand, scraping over rails, pipe, concrete, etc. In all sizes and types—in cases or reels. Ask your dealer—or write for catalog.

EST. 1867
KEUFFEL & ESSER CO.
NEW YORK • HOBOKEN, N. J.

dent is W. H. Booth, in charge of the Seattle branch. W. T. Euster was elected secretary; R. W. Wright, treasurer, and Oscar Furuset, director and attorney. Other employees now stockholders are Charles B. West, Merrill R. Jackson, Robert F. Nute, Jr., Harold Ness, A. M. Logan and E. L. Booth.

The firm handles construction and logging equipment.

AMERICAN CAR AND FOUNDRY CO. announces the appointment of J. L. Wood as assistant vice president. Mr. Wood has served in the engineering department for more than thirty-eight years.

He attended Alabama Polytechnic, where he was graduated with an engineering degree.

Mr. Wood began his association with American Car and Foundry in 1906, acting as local engineer in the Memphis plant. In 1928, he transferred to the New York office as assistant mechanical engineer in the engineering department, and in 1936 he was appointed mechanical engineer.

H. B. LILLEY, former chief inspection engineer, has been appointed to sales development engineer for the steel and tube division, Timken Roller Bearing Co., Canton, Ohio. He will specialize in the application of mechanical tubing to machine tool products and other engineering applications. He has served in various steel and tube division positions connected with inspection of tubular products since he joined the Timken organization. In recent years he has specialized in the development of tubing applications for the aircraft industry.

GENERAL CABLE CORP. has announced that, effective March 1, all reels, spools and cases will be shipped to customers on a "no charge" basis. Containers now in the hands of customers and for which they have been billed may be returned for credit up to and including Feb. 28, 1945.

MAJ. R. C. (REX) LARKIN, Tractor and Crane Section, Office, Chief of Engineers, Washington, D. C., has retired to an inactive Army status and returned to the presidency of the R. C. Larkin Co., Chicago, Ill., distributors of heavy construction and road maintenance machinery.

D. S. MCAFEE, vice president and a director of The Dorr Co., New York, has arranged to terminate his association

There's money for you in using this new handbook

to save time, trouble and expense

Estimating, Planning, Constructing Brick Masonry of all types

HERE is the book for all interested in efficient and economical planning and erection of brick masonry construction. It is a professional handbook of the field full of useful definitions, descriptions, data, diagrams, methods, practical pointers covering all types of constructions—everything from common and special bonds to estimating the rental cost of scaffolds. This dependable manual will help you to estimate brick masonry construction accurately—to meet specifications better—to find quickly the technical details that save time and expense.

Use it for access to information that will solve scores of troublesome on-the-job problems.

HANDBOOK of BRICK MASONRY CONSTRUCTION

By JOHN A. MULLIGAN

Mason Contractor and Builder

526 pages, 6x9, 163 illustrations, 219 tables $5.

- Details of every type of bond, how to make joints, handling work under various conditions, preparation of mortar—
- How masonry materials are made, characteristics, how they perform, how to test them—
- Concrete construction, use of common, face, hollow tile, stone masonry, architectural terra cotta, etc.—
- ESTIMATING — formulas, pointers and tables to help you determine quickly, material, labor, time, and costs—
- —in these and scores of other topics the book is dotted with experience-grounded data and pointers.

10 DAYS' APPROVAL
McGraw-Hill Book Co., Inc.
330 W. 42nd St., New York 18

Send me Mulligan's Handbook of Brick Masonry Construction for 10 days' examination on approval. In 10 days I will send you $5.00 plus few cents postage or return book postpaid. (Postage paid on cash orders.)

Name .....
Address .....
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(Books sent on approval in U.S. and Canada only)

ERE'S THE *Answer*

TO YOUR REMODELING PROBLEMS

—MUELLER BRASS CO—PORT HURON MICH—STREAMLINE—HARD—GOVT—TYPE M—
—MUELLER BRASS CO—PORT HURON MICH—STREAMLINE—HARD—GOVT—TYPE M—

● If your post-war plans call for the purchase ipe and fittings on remodeling city projects, new construc- or water service lines, investigate the many superior ities of STREAMLINE Copper Pipe and Fittings before you ly decide.

nstallation of STREAMLINE Copper Pipe connected with EAMLINE Fittings compares very favorably in cost with able pipe, yet with the possible exception of abnormal and water conditions, it never has to be replaced on ount of rust or breakage.

ontrast to threaded connections the pipe joint of a EAMLINE installation is actually the strongest point in the —constant vibration, resettlement of filled earth, etc., has effect upon it.

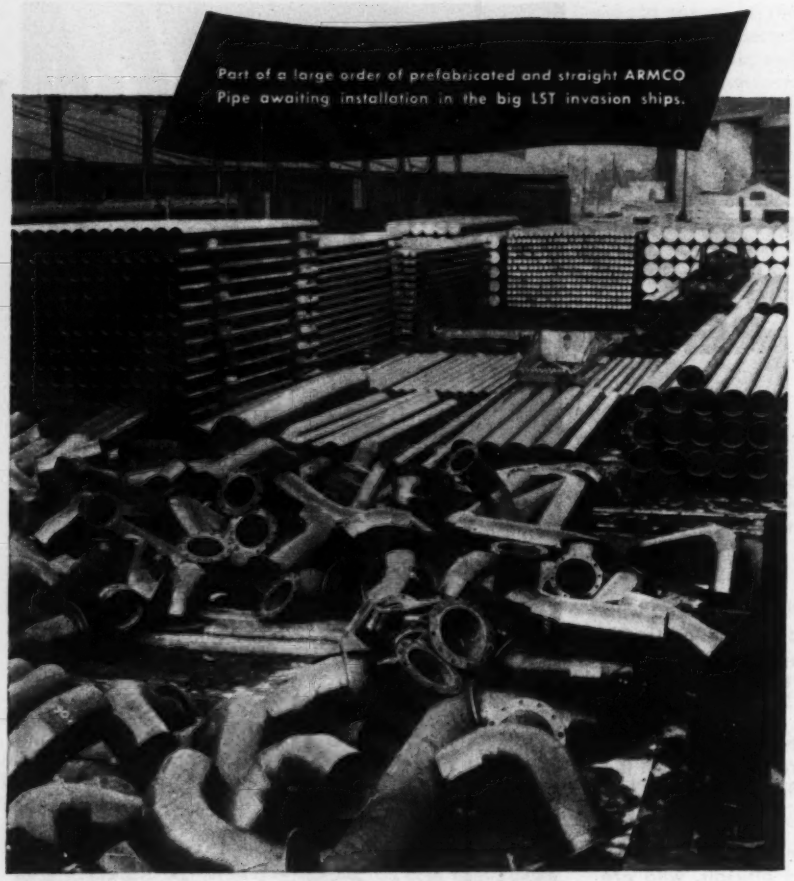
EAMLINE Copper Service Pipe represents one of the lowest forms of insurance that water works officials, who are ponsible for the return on a heavy capital investment, can pt.

EAMLINE Solder Fittings and Copper Pipe are the most ient materials for water works use, for general plumbing heating, for many applications in filtration plants, in ation lines and in heating coils using the sludge digestion em in sewage disposal plants.

EAMLINE Copper Pipe and Fittings are at present used % for war purposes, but it is not too early to plan again their peacetime use in the near future when they will in be available.

AK PROOF
TROUBLE PROOF
VIBRATION PROOF
FOOL PROOF

STREAMLINE
PIPE AND FITTINGS DIVISION
MUELLER BRASS CO.
PORT HURON, MICHIGAN



LST Builders "LEARNED THEIR PIPE"

From Many Industrial Users

Just as ARMCO Spiral Welded Steel Pipe simplifies industrial piping jobs, it is helping to turn out LST's *faster* for attacking the enemy.

Whether used for motor exhausts or ventilating equipment on the big assault craft, this sturdy pipe goes in fast because it is prefabricated to exact specifications. Even complicated assemblies are installed easily and quickly.

For years this made-to-order steel pipe has been used in many kinds of industrial piping jobs. If you need pipe for maintenance or war work in your plant, consider these and other practical advantages of ARMCO Spiral Welded.

Fittings come welded to straight pipe runs. This means fewer flanges, fewer joints — less chance for leaks. Welding is no problem because the steel is carefully selected for its welding qualities.

We'll be glad to assist with your special industrial piping problems. Sizes of ARMCO Spiral Welded range from 6 to 36 inches; wall thicknesses from 9/64 to 1/2-inch. Write for the informative, illustrated bulletin—"6" to 36" Pipe for Industrial Uses." The American Rolling Mill Company, 1391 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

ARMCO

ARMCO 6" TO 36" STEEL PIPE

with the company. Mr. McAfee has ... several years specialized in equipme... and methods for the process industri... His work has been carried on not on... in the North American continent, b... also in South America and parts of t... Far East and Europe.

J. S. HAZEN, formerly manager of t... Rock Drill Sales Division of the Chica... Pneumatic Tool Co., is now associat... with the Worthington Pump and M... chinery Corp. as manager of their mi... ing drill division, with headquarters ... the Worthington Holyoke works, Ho... yoke, Mass. For many years Mr. Haz... has been engaged in the sale of ro... drills in both domestic and export fiel... and in mine operations in the weste... United States, Mexico and South Ame... ica.

THE MARION STEAM SHOVEL CO., Ma... ion, Ohio, announces the appointment ... Walter N. Westland as sales manage... Mr. Westland joined the Marion organ... zation in 1925, upon completing h... studies at Massachusetts Institute ... Technology, where he was graduated ... civil and highway engineering.

After a year at the main office and ... the plant, Mr. Westland was transferr... to the New York sales office, where h... came in contact with the market f... power shovel equipment and with ma... rial handling. In 1927 he was tran... ferred to the New England sales branc... as sales representative, being made di... trict manager in 1932. In the past ye... and a half, Mr. Westland combined h... New England activities with Washin... ton contacts, where he worked close... with the various Governmental offic...

VULCAN IRON WORKS, Wilkes Barr... Pa., announces the appointment of E. ... McSweeney as president, succeeding ... Perry Holder, who resigned seve... months ago to become president ... Wickwire-Spencer Steel Co.

Mr. McSweeney was formerly vi... president of the Baltimore & Ohio Ra... road, in charge of motive power. H... appointment completes a reorganizati... recently instituted by the appointme... of F. A. Stead as vice president ... charge of sales and F. M. Kern as v... president in charges of operations—bo... of whom have long records of success... achievement in their respective fiel...

UNIVERSAL ATLAS CEMENT CO., Unit... States Steel Corp. subsidiary, announc... the appointment of Fred T. Wiggi... sales manager, Birmingham, Ala., ... assistant to vice president, general sal... New York, and the appointment of Ro... ert H. Bond as sales manager, Birmi... ham.

Mr. Wiggins, after attending T...

Arrange Your CONCRETE PATCHING SCHEDULE for 24 Hour Repair Service

Pavement patching must not be permitted to delay vital wartime traffic with sign cluttered pavements and extensive detours. Old-fashioned patching methods and delayed repairing are inadequate to meet the wartime need for uninterrupted flow of materiel.

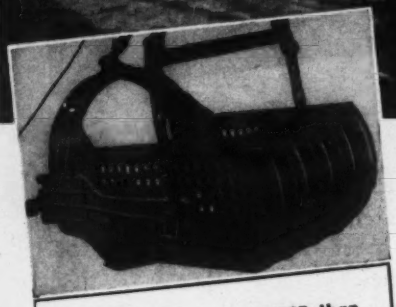
Twenty-four hours is plenty of time for concrete to acquire safe opening strength. This is true even at low temperatures when proper cold weather concreting practices are followed. Just take advantage of the property of calcium chloride to produce required opening strength in about half the usual time.

The gains in strength resulting from the use of calcium chloride are uniform in mixes with either standard portland, high-early-strength or air entraining cement. No matter which cement you use calcium chloride will cut in half the time required to provide good patches. And, with calcium chloride in the mix you also get "built-in curing" to produce higher strength at all ages.

Our technical bulletins and our booklet, "Early Strength Concrete" are available on request.

CALCIUM CHLORIDE ASSOCIATION
4145 Penobscot Building **Detroit 26, Mich.**

PAY DIRT REMAINS IN THE BUCKET



★ 20% to 40% LIGHTER than other buckets, type for type.

★ 10% to 14% MANGANESE steel chains and fittings.

★ Perfect distribution of weight provides greater ease of handling.

★ ALL-WELDED construction ...no rivets to work loose.

AVAILABLE in 3 TYPES: ⅜ to 20 yards. With or without perforations. Write today for specifications, descriptive literature and prices.

THE ROUND *Perforations* ARE AN EXCLUSIVE FEATURE

Get bigger payloads in wet digging with a Hendrix Lightweight. The perforations let the water run through, and provide a capacity load each trip. Their round design eliminates breaks which occur regularly in buckets perforated with square holes or made with lattice pattern.

HENDRIX *Lightweight* DRAGLINE BUCKETS

DESOTO FOUNDRY, INC · MANSFIELD, LOUISIANA

TRACK HAULAGE IS CHEAPER HAULAGE

PLYMOUTH LOCOMOTIVES

• FROM 2½ TO 70 TONS •

PLYMOUTH LOCOMOTIVE WORKS

Division of The Fate-Root-Heath Co., PLYMOUTH, OHIO, U. S. A.

Citadel, Charleston, S. C., and be graduated from Duke University, D ham, N. C., joined the sales departm of Universal Atlas Cement Co. in 19 and held various positions until 19 when he was appointed sales manag Birmingham.

Mr. Bond attended Georgia School Technology. He joined Universal At Cement Co. as a salesman in 1927. Fr 1932 until 1939, he was engaged in oil business, and returned to the cem company in 1939 as a salesman, his recent appointment as sales ma ger, Birmingham, in charge of sales Alabama, Georgia, Florida, Mississi South Carolina, and Tennessee.

ADDITION of six factory service sales offices has been announced Genesee Tool Co., Fenton, Mich., p ducers of "Tomahawk" cutting to The new offices are in Dayton, O (710 Harries Bldg.); Cleveland, O (Penton Bldg.); South Bend, Ind., (Tower Bldg.); Toledo, Ohio, (1506 ledo Trust Bldg.); Pittsburgh, (1217 Grant Bldg.); and Indianap Ind., (1109 Fletcher Trust Bldg.)

H. E. Roedter is the Dayton distr manager, with George Pierce head the Cleveland staff. The South Be office is under T. S. Mellen, while W Haverstock and M. Tague are in cha of the Toledo office. J. Armstrong Indianapolis district manager.

R. G. PARK has been appointed mate controller of the Shipbuilding Divisi Alabama Dry Dock & Shipbuilding C Mobile, Ala.; for many years he principal purchasing agent of Merr Chapman & Scott, New York contra ing firm.

THE WELDWOOD PLASTIC GLUE DEPA MENT of United States Plywood C has moved its headquarters from Park Ave., to the building at 55 W 44th St., New York City, which the poration recently purchased. It is first division of the corporation to m into the building, which ultimately house all the New York offices.

BAILEY METERS AND CONTROLLERS

FOR SEWAGE TREATMENT AND WATER SUPPLY . . .

BAILEY METERS

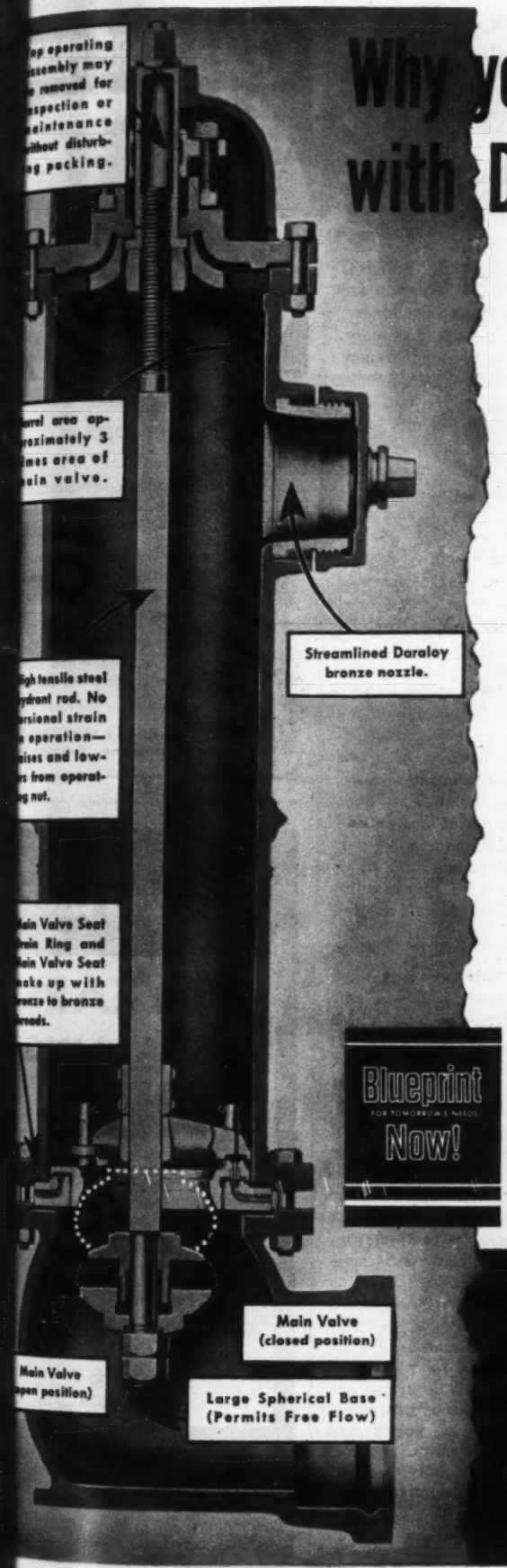
● Venturi Tubes, Weirs, Flumes, Nozzles and other primary elements; Mechanically and Electrically operated Registers and Complete Automatic Control Systems.

BAILEY METER COMPANY

1029 IVANHOE ROAD • CLEVELAND, O.

Bailey Meter Co. Ltd., Montreal, Canada

Why you get full protection with DARLING HYDRANTS



1. FIRE FIGHTING EFFICIENCY—Maximum water delivery at the nozzles with no perceptible loss of pressure is obtained by: (1) extra large diameter barrel; (2) streamlined nozzles; (3) venturi-type waterway through valve seat opening; (4) main valve position, when open, being well below valve seat, offering minimum restriction to water flow; (5) spherical base larger in cross section than pipe connection. No obstructions to impede flow of water, no pockets to collect sediment.

2. NO FLOODING—The compression type valve closes with line pressure, guards against street flooding in case of traffic damage.

3. NO FREEZING—Positive automatic drain prevents freezing. The simple two- or three-port drain valves are automatically operated as main valve is opened or closed.

4. EASY MAINTENANCE—No need to remove entire hydrant. Just a *one man* job to remove and inspect all working parts of hydrant. The complete working assembly, including main valve, main valve seat, drain valves, and drain valve seats comes out as a unit on the hydrant rod without disturbing the hydrant barrel or ground around hydrant.

5. LONG LIFE—The large Darvaliron barrel with thick wall and rugged construction throughout insures strength. Heavy Daraloy bronze is used wherever corrosion or rust may interfere. All internal parts are extra heavy to withstand operating abuse. Barrel castings are painted inside and out with special primer. Sections below ground are given two coats of special black asphaltum paint which resists corrosive action of soil and moisture.

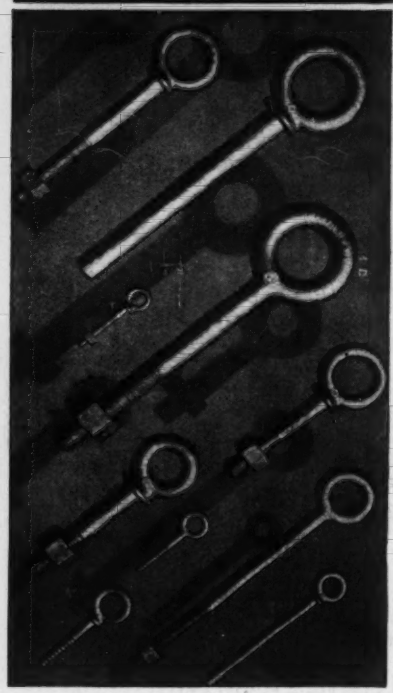
6. ADAPTABILITY—Hydrant length may be standardized throughout the city, using extension pieces for grade changes—thus all hydrant parts become standardized.

7. FINE APPEARANCE—The attractive rugged appearance of the Darling hydrant symbolizes dependable fire protection.

Darling hydrants are specified by leading city engineers in all parts of the country. Further information in our new 302-page Catalog No. 17. Write for it.

DARLING
FIRE HYDRANTS
A Product of
DARLING VALVE & MANUFACTURING CO.
Williamsport, Pa.

SPECIALS WASTE TIME
...TRY LAUGHLIN'S
STANDARD LINE
EYE BOLTS
FOR ALL JOBS



Keep your eye on this picture if you're thinking of having special bolts made up. Every minute counts! Laughlin standard eye bolts will likely fill the bill. All weldless — all drop forged steel. Nut type with extra length threads for extra adjustment. Send for latest Laughlin Catalog showing standard stock eye bolt sizes in nut, screw and rivet types.

Sold Through Oil Field Supply Houses.

Look for Laughlin Products in Metal & Nonmetallic Mining Catalog Powers Road & Street Catalog

Write for Latest Catalog on Laughlin Industrial Hardware

FORGING A SHARE IN VICTORY

THE THOMAS LAUGHLIN Company PORTLAND 6, MAINE

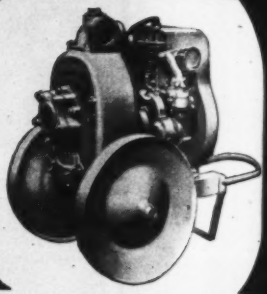
Arc Welding—A booklet, "Practical Design for Arc Welding," tells how arc welding is used for wire mill machinery, truck frames, coal mining machinery, steel mill machine frames, among many other things. Those responsible for the development of products for the post-war period undoubtedly should place arc welding high on the list of production procedures and the charts in this booklet should help materially.—*The Hobart Brothers Co., Troy, Ohio.*

Fire Extinguishing Systems—A folder explains the outstanding features of fire extinguishing systems, as follows: How five fire extinguishing requirements are met in a single system; How systems are engineered for the specific hazards covered; How carbon dioxide is given enhanced fire extinguishing performance; How carbon dioxide is released in mass discharge at high rate of application; How one hazard or many can be protected by a single system; Illustrates various types of hazards and the type of application required for each; Typical performance data under extreme conditions, with photographs. —*Cardox Corp., 307 No. Michigan Ave., Chicago, Ill.*

New Insulation Materials: a booklet, "Foam-Glas Insulation for Roofs," describes a new insulation material which will find many uses in construction. It is made from cullet—pulverized glass—to which a small proportion of finely divided carbon is added. The chemical reaction is analogous to the raising of bread dough with yeast. When the glass is in molten form, certain oxides react with the carbon to make carbon monoxide and dioxide gases, which are trapped within the glass to form tiny, sealed air chambers. These cells number five million in a cubic ft., making the weight of the material about 10.5 lb. per cu.ft.

Cellular rather than porous, the insulation is impervious to water and vapors, a property available in few materials. Other advantageous properties, in addition to its light weight and vapor-tight cellular structure, are high compressive strength, rigidity, high resistance to fire, ease of installation, low cost, and durability. The inorganic substance is not harmed by acid atmospheres or solutions destructive to

JAEGER "SURE PRIME"



—the Pumps that exceed their promises

with up to 5 times faster priming, with hi-head, hi-capacity performance, with thousands of extra hours of trouble-free service.

Self-cleaning design, replaceable liners, longest life seal, heavy duty construction thruout.

Every unit individually tested and certified — you know you're getting the best.

Sizes 3000 to over 200,000 G.P.H.

52 Lb. Bantam —3000 G.P.H.

THE JAEGER MACHINE CO. 200 Dublin Ave., Columbus, Ohio

MacArthur

34 YEARS INSTALLING PILES

OF EVERY TYPE

CAST-IN-PLACE
CONCRETE
COMPOSITE
STEEL
SECTIONAL PIPE
TIMBER

SOIL AND ROCK EXPLORATION

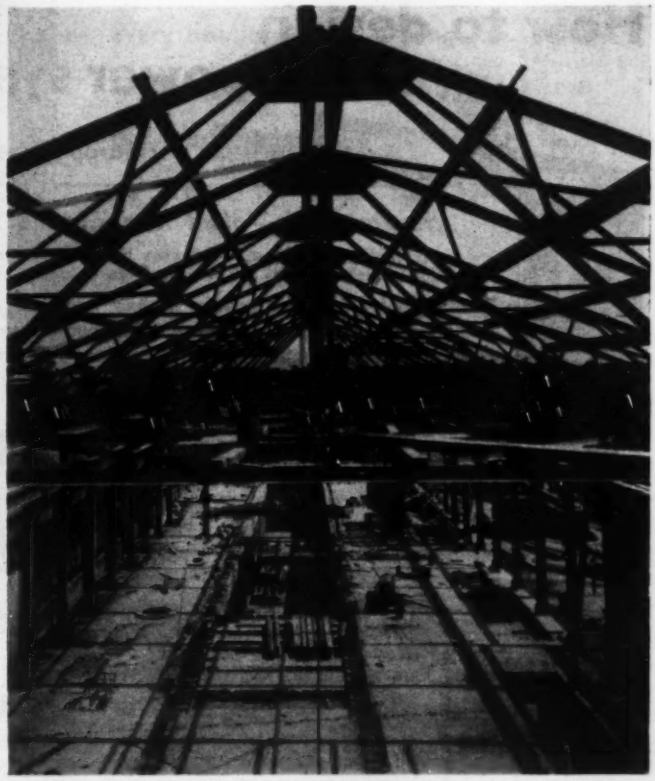
MacARTHUR CONCRETE PILE CORP.
18 EAST 48th STREET, N. Y. C.
Boston • Cincinnati • New Orleans

INGALLS
STEEL

For Economy in Design, Fabrication and Erection

Interior view of the Masonite Corporation's warehouse at Laurel, Miss., built with structural steel from Ingalls Iron Works Company.

Ingalls engineers are *practical*. When there's a design to be made, steel to be fabricated, a structure to be erected, they'll find ways to save and improve on every step. The acknowledged pioneer in arc-welding to replace riveting, Ingalls has perfected many other designs and methods to produce stronger, faster construction of ships, buildings, bridges and industrial plants. Consult Ingalls, the nation's largest independent fabricator of structural and plate steel, on any current or future plans which involve the use of steel.



Construction photograph of #7 machine room in the Bogalusa, La. plant of Gaylord Container Corporation, showing steelwork supplied by Ingalls.

THE INGALLS IRON WORKS COMPANY, THE INGALLS SHIPBUILDING CORPORATION, The Steel Construction Company, Birmingham Tank Company. Offices at BIRMINGHAM, New York, Washington, Pittsburgh, New Orleans. Shipyards at Pascagoula, Mississippi and Decatur, Alabama.

THE

PRELOAD

REG. U. S. PAT. OFF.

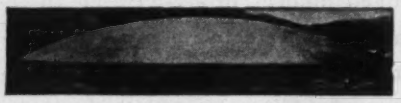
SYSTEM

Crackless Concrete Construction

THE patented Preload system of tank construction permits substantial economy in steel and concrete, with consequent savings in cost. Under the Preload system the concrete is permanently maintained in horizontal and vertical compression, thereby completely eliminating cracking or leakage.

Included among the 500 Preload tanks in service are the largest concrete surface tank, largest concrete standpipe, and largest self-supporting concrete dome.

DESIGNERS and BUILDERS of PRELOAD TANKS, ELEVATED TANKS, STANDPIPES, DOMES, PRESSURE VESSELS and CONTAINERS, and CARRIERS of LIQUIDS and DRY CHEMICALS



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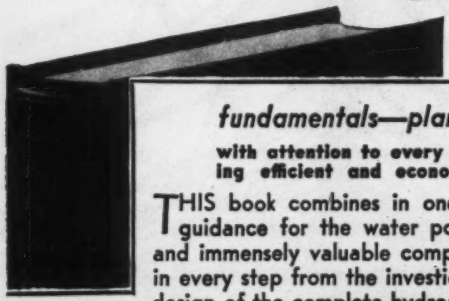
420 LEXINGTON AVE. ★ NEW YORK, N. Y.

Boston · Washington · Montreal · Toronto

How to design water power systems



a thorough treatment of fundamentals—plant location and design

with attention to every factor important in developing efficient and economical hydroelectric projects

THIS book combines in one volume textbook and reference guidance for the water power engineer—descriptive details and immensely valuable comparative data to help the engineer in every step from the investigation of water power sites to the design of the complete hydroelectric system.

JUST OUT!

COVERS:

Water Power Development — Distribution and Use
Hydrology
The Study of Streamflow Data and Water Power Estimates
Hydraulic Turbines
General Arrangement of Plant
The Dam
The Waterway — Canals and Penstocks
Powerhouse and Equipment — Hydraulic and Structural
Powerhouse — Electrical
Plant Accessories
Speed and Pressure Regulation
Transmission Lines
Cost and Value of Water Power
Reports and Plant Descriptions
Hydroelectric Development

WATER POWER ENGINEERING

BY H. K. BARROWS

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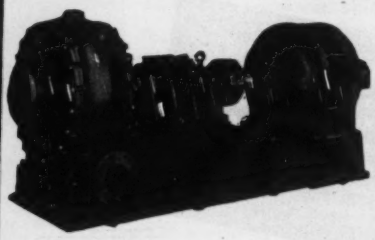

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The body of the table gives the exact center distances for a chain of one-inch pitch and of the length listed in pitches in the first column. Center distances for any pitch of chain may be obtained by multiplying the centers in the table by the pitch.—*Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.*

Valve Selection—A new valve selection chart is available on heavy cardboard. It offers a "slide-rule" for valve selection. An additional feature is a comprehensive explanation below the breakdown and also an example which uses the facts brought out in the chart for selecting the right valve for a specific condition.—*Reading-Pratt & Cady Division of American Chain & Cable Co., Inc., Bridgeport, Conn.*

Excavation News—The "Shovel News," a pictorial news bulletin of important activities and developments in the field of excavation will be published periodically this year. The first 1944 issue high-spotted the Alaska Highway construction job. A feature is large photographic reproductions of on-the-job scenes.—*Excavator Division, Harnischfeger Corp., Milwaukee 14, Wis.*

V-Belt Drives—A 384-page catalog is a complete encyclopedia on the V-belt drive, offering engineers valuable and comprehensive information. It contains drive selection tables that list millions of drive combinations, relieving the user of all calculations, engineering and complicated formulas. Everything is accurately worked out for instant use.

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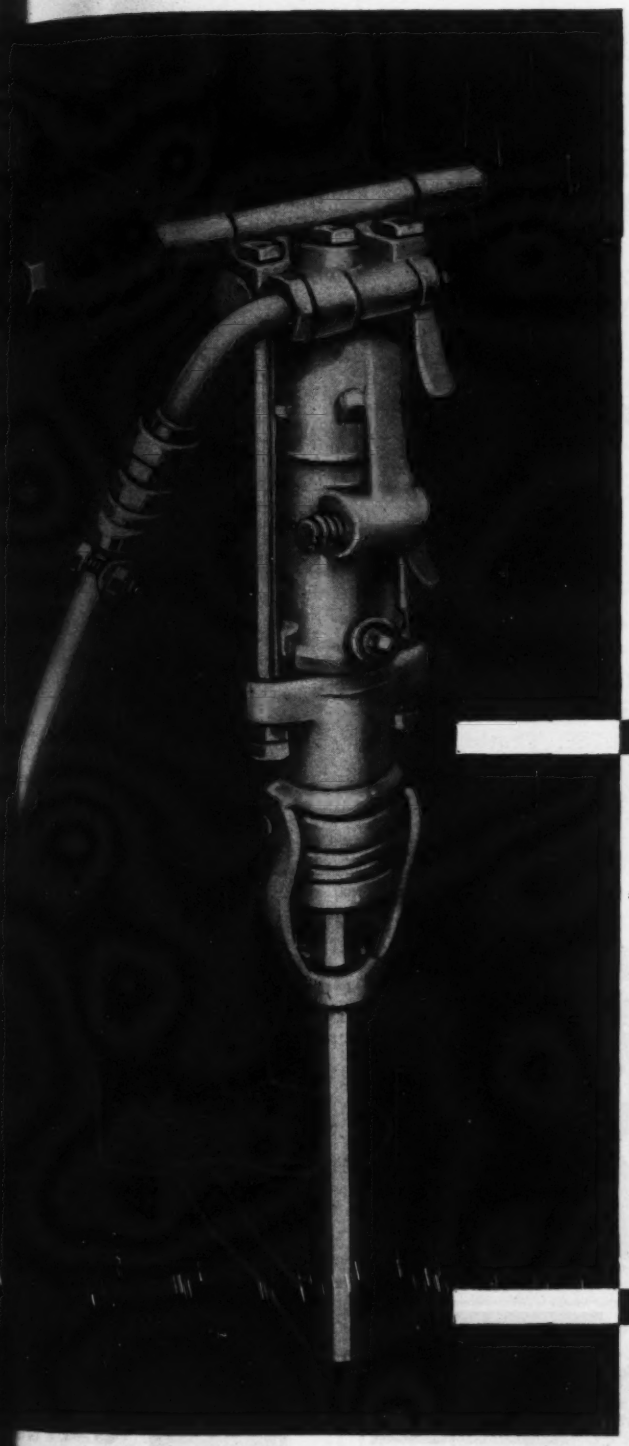

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The second section of the booklet devoted to porous bronze, porous i and D-10 graphite impregnated br bearings. In addition to listing standard shapes and sizes availa technical data on performance, inst ation, and care are included.—*Keyst Carbon Co., Inc., Saint Marys, Pa.*

Modern pH and Chlorine Control— revised 83-page combination handb and catalog of value to every wa sewage and power plant engineer available. Fifty pages are devoted (1) a simple, non-technical explanati of the meaning of pH control and methods for making colorimetric de minations; (2) precautions to observed; (3) discussion of the appli tion of pH and chlorine control to different fields, including water purifi tion and softening, sewage dispo boiler water, etc.; (4) a technical cussion of the meaning of pH contr These four sections bring together, condensed form, information wh cannot be obtained elsewhere except reference to innumerable textbooks original articles. The remaining pages describe slide comparators general pH and chlorine control, de mination of phosphates in boiler wa and for analysis of water for nitri nitrates, silica, iron, ammonia, etc *W. A. Taylor & Co., 7300 York Ro Baltimore 4, Md.*

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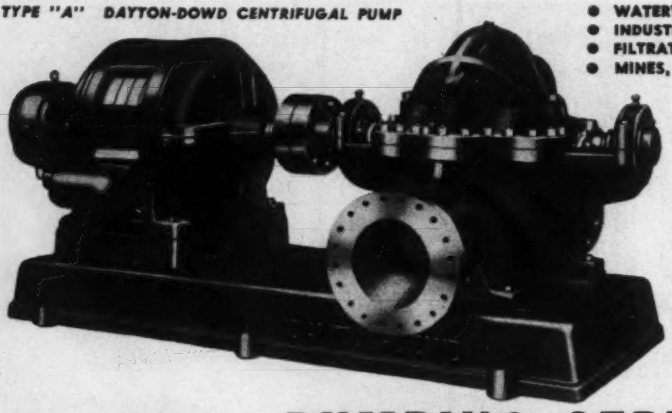

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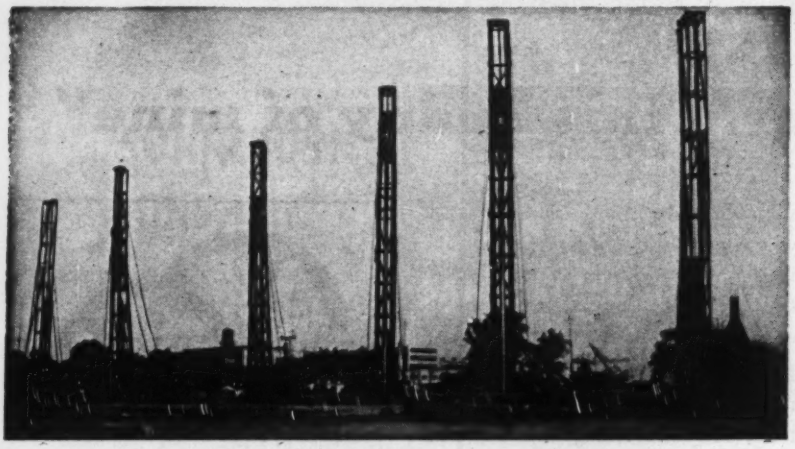

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MEETINGS

AMERICAN WOOD PRESERVERS ASSOCIATION, annual meeting, Palmer House, Chicago, Ill., April 26.

REGIONAL AND LOCAL MEETINGS

NEW JERSEY SEWAGE WORKS ASSOCIATION, 29th annual meeting, Stacy-Trent Hotel, Trenton, N. J., March 23-24.

MICHIGAN ROAD BUILDERS' ASSOCIATION annual meeting, Hotel Statler, Detroit, Mich., April 3.

THE MICHIGAN ENGINEERING SOCIETY 64th annual convention, Pantlind Hotel, Grand Rapids, April 13-15.

FLORIDA ENGINEERING SOCIETY, annual meeting, Miami Beach, Fla., April 27-

NEW JERSEY SECTION, AMERICAN WATER WORKS ASSOCIATION, Trenton, N. J., May 11.

MARYLAND-DELAWARE WATER AND SEWERAGE ASSOCIATION, 18th annual conference, Lord Baltimore Hotel, Baltimore, Md., May 19-20.

MIDWEST POWER CONFERENCE, Palmer House, Chicago, Ill., April 13-14.

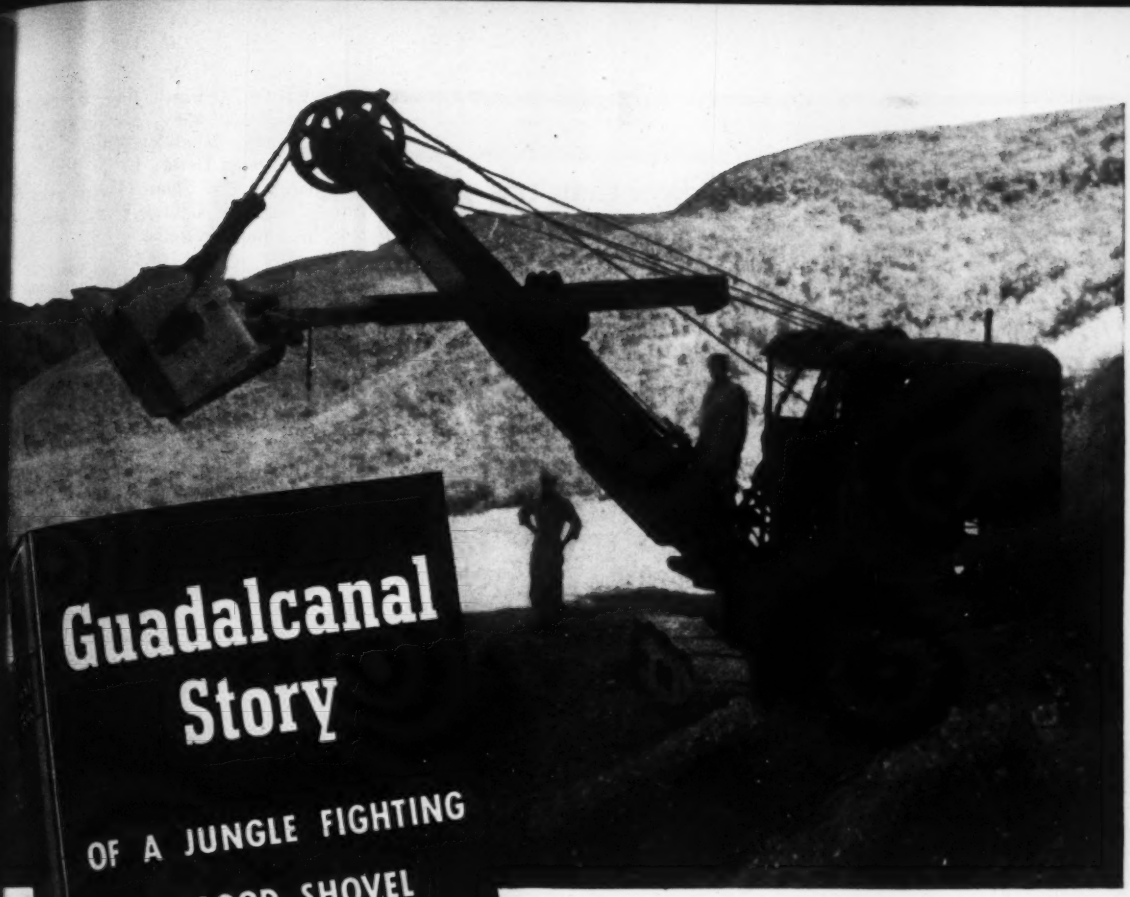
NEW ENGLAND SEWAGE WORKS ASSOCIATION, spring meeting, Hotel Kimball, Springfield, Mass., May 17.

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, The Hotel Statler, Boston, Mass., May 18-20.

Elections and Activities

H. L. Dickson, Little Rock, is the new president of the Associated General Contractors of Arkansas. D. F. Jones is vice president, Ray Metzger, secretary-treasurer and William Peterson, first vice president.

Walter O. Dow, engineer-manager of the Emmet County Road Commission, has been elected president of the County Road Association of Michigan. Herman A. Johnson, of the Kent County Road Commission, was elected vice president and L. F. Levin, Chippewa County road engineer, was re-elected secretary-treasurer. Members of the board of directors



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John Anderson, of Charleston, h been elected president of the South Ca olina Society of Engineers. Other offic are C. R. McMillan, of Columbia, v president, and A. E. Johnston, of Colu bia, secretary-treasurer.

Chief Highway Commission J. S. W liamson, of Charleston, was elected pre ident of the state section of the Am ican Society of Civil Engineers.

Herman B. Wolfe has been install as president of the Charlotte, N. C., E gineers Club to succeed Morris Russe

R. Allen Thomas was installed president of the Winston-Salem, N. C Engineers Club January 11 to succe Arvin Page.

Other officers installed are: N. Cromer, vice president; R. M. Roge secretary; and M. D. Brown, treasur

Directors installed for two-year ter are: C. E. Stephenson and J. O. Spe

William J. Secrest is the new pre dent of the Akron, Ohio, district S ciety of Professional Engineers. Oth officers are L. J. Hoffman, city wate works engineer; first vice president; R P. Krebs, second vice president; Thom Sauter, Cuyahoga Falls city engine secretary; and D. W. Converse, trea urer.

The Idaho chapter of the Associat General Contractors has been admitte to membership in the Northwest branc of the A.G.C., as has the Portland, Ore Building chapter. Noble W. White Seattle has been elected to head th Northwest branch organization for 194 supported by J. B. Warrack, Seattl treasurer and B. F. Turnbull, Seattl secretary.

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